The Birth of Ham VHF FM - The 1960s History

Including some copies of the publications that helped get it started

By the mid-to-late 1950s a few hams were already beginning to convert crystal-controlled commercial FM gear for 6 and 2 Meter operation. By 1960 it was apparent that changes in FCC regulations were going to make much of the FM gear in use by commercial services obsolete. High-Band gear and items like this Low-Band Mobile Receiver were already showing up as surplus with a glut sure to follow. Unfortunately, when picking frequencies for new FM nets localities were choosing frequencies seemingly at random leaving the gear useless when traveling.

In the early 1960s several hams working for GE's Mobile Radio Department in Lynchburg, VA recognized the absurdity of this and set about to bring some standards to the frequency selection process. A national first-frequency of 146.94, with other channels spaced multiples of 60 KHz from it and a minus 600 KHz separation for the corresponding repeater input frequency were promoted for 2 Meters. 146.94 MHz was chosen because it was the highest 60 KHz channel that Technician Class hams could operate on at that time as well as being closest to the original 150+ MHz operating range of the commercial gear. Six Meter operation was already going strong in the mid-west on 52.525 MHz and it was promoted as a first 6 Meter channel.

The GE hams published mimeographed "FM Nets" and "FM News" to help spread the standards. Warren Middleton (SK), W4DYE (later W8CXD) - George Rose (SK), W4GCE - Seymour Paul, K4FSU and Tom McKee, K4ZAD were the most active in this effort.

Despite some WBFM activity as early as the mid-1950s (Chicago, Indiana, Syracuse and perhaps others) page 95 of the November 1961 QST has probably the first ARRL recognition of VHF Wide-Band FM via converted surplus commercial gear. But, despite our continued efforts and the ever-increasing VHF FM activity, the ARRL was mute for all of 1962 and part of 1963. However, by unanimous vote at the May 1963 ARRL Board meeting the Board directed the listing of 52.525 and 146.94 in each QST as Suggested Operating Frequencies for Wide Band FM. See the Board meeting minutes in the July 1963 QST, page 63. The first listing of the frequencies is on page 99 of the same issue.

As FM operation spread across the country 2 Meter repeaters appeared on many 60 KHz spaced channels, and soon others got involved in the standardization efforts which evolved into the VHF/UHF band-plans in use today.

Recently some copies of "FM Nets" and "FM News" were found and scanned. The early issues were composed on a typewriter and the later ones on a Teletype machine using punched tape to make typing-error corrections quick and to easily make the additional mimeograph masters needed for the larger circulation. Reproduction was by a labor intensive mimeograph process using trays of blue gel which would only produce a limited number of readable copies from the master. The blue print on many pages is quite faded and restoration efforts were not always as successful as one might desire, but here they are in PDF format. These documents may appear directly in your browser or as PDF downloads.

FM Nets was the first publication in 1960. The first issue is missing. Beginning with the third issue of FM Nets 52.525 MHz and 146.94 MHz were promoted as first FM frequencies to be activated in new locales. Most of the detailed net data has been omitted from these PDFs:

40F3_Nets_2 FM_Nets_3 FM_Nets_4 FM_Nets_5

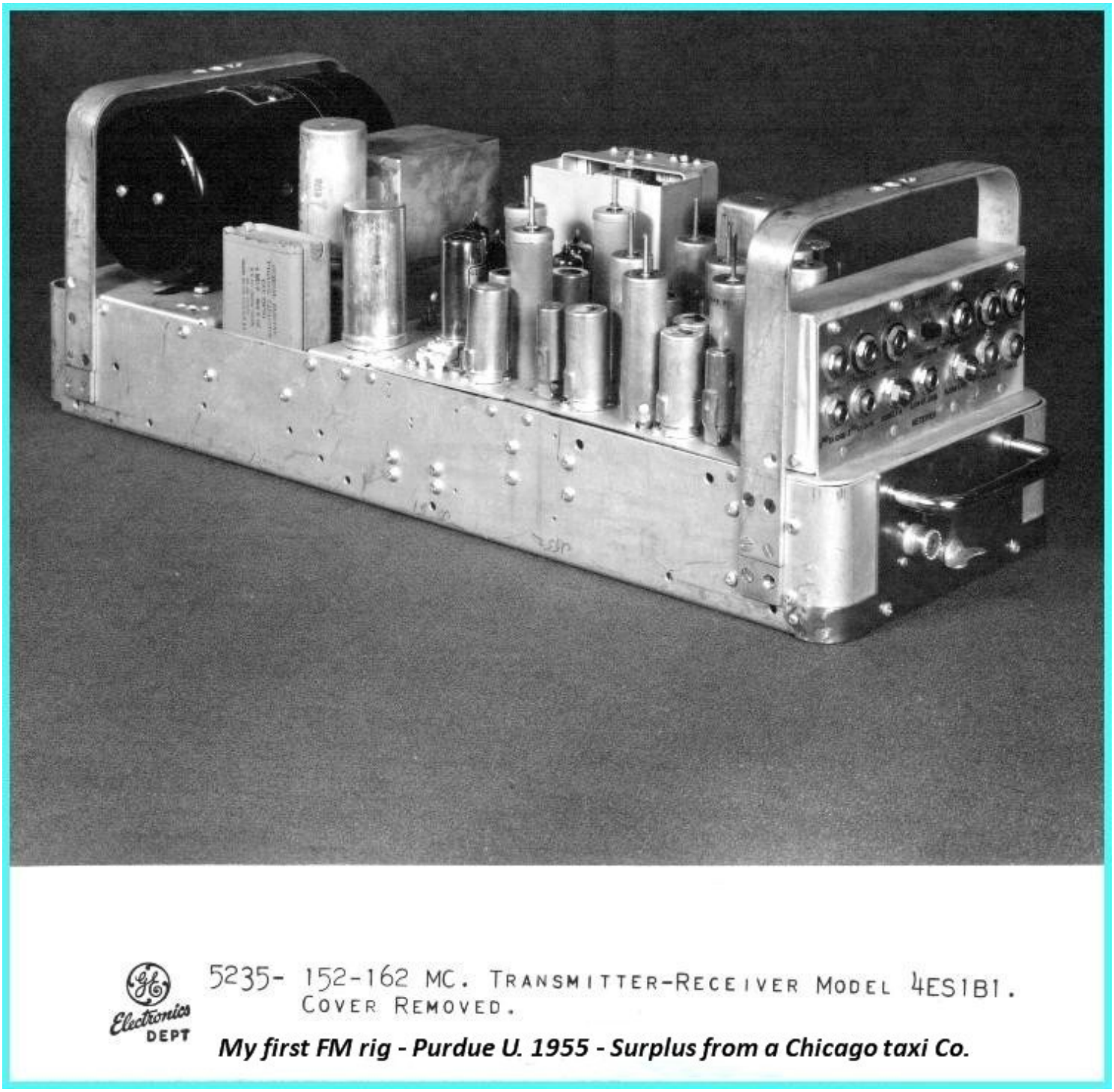
Publication of FM News followed in 1962. Issue 4 is a superb remote-station and repeater dissertation by Warren, W4DYE-W8CXD.

FM_News_1 FM_News_2 FM_News_3 FM_News_4 FM_News_5

1961 promotional efforts also included a Why These Frequencies sheet, and two small handout sheets intended for distribution at club meetings and hamfests. One promoted FM, 52.525 MHz, 146.94 MHz, and the other urged FM users to contact ARRL to get the frequencies mentioned monthly in QST. As noted above, by mid-1963 these efforts were successful in getting the ARRL involved in the standardization of VHF-FM channels.

Hope you enjoyed this bit of Ham-Radio history.

Tom McKee, K4ZAD
Cary, NC



5235- 152-162 MC. TRANSMITTER-RECEIVER MODEL 4ES1B1.
COVER REMOVED.

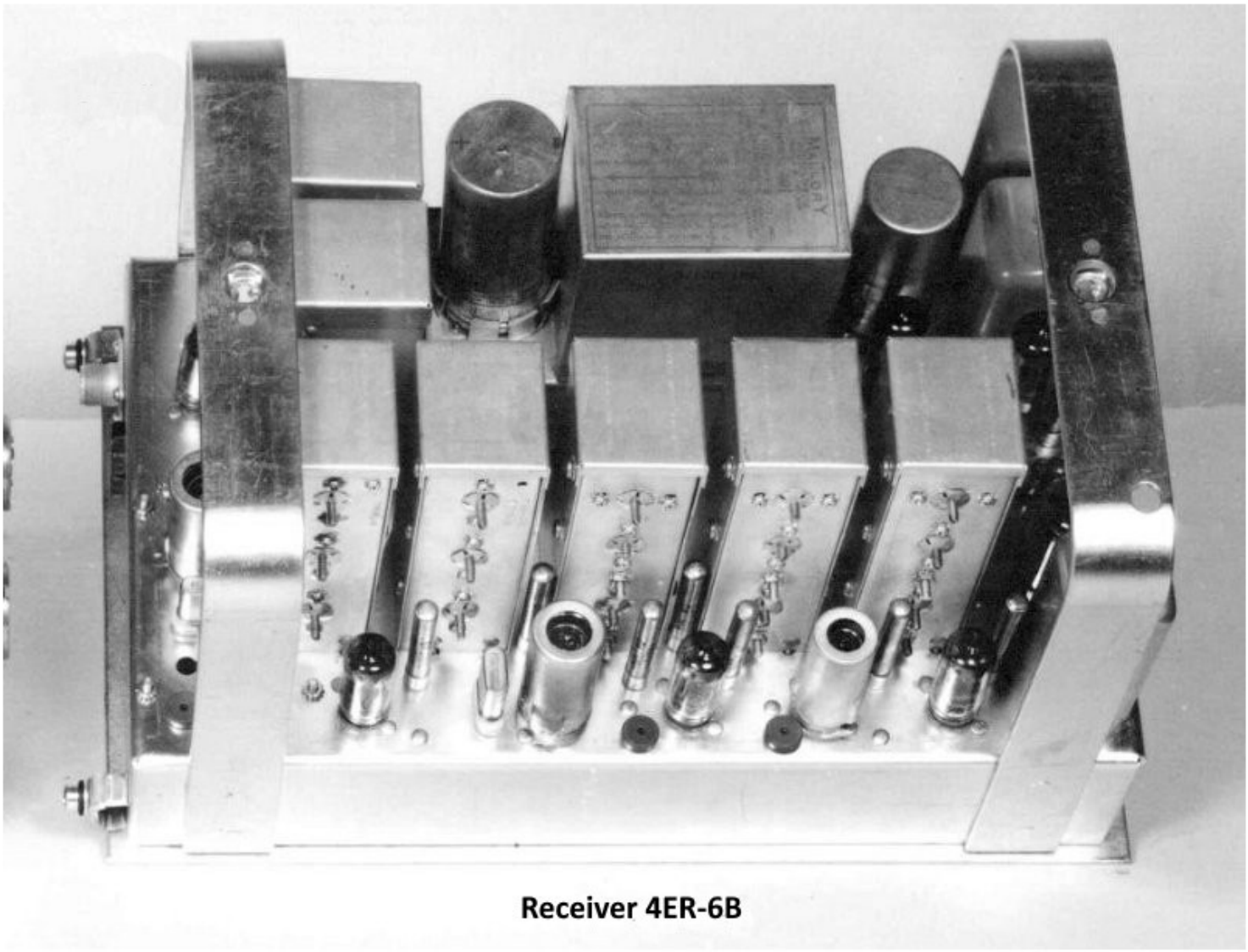
GE Electronics DEPT

My first FM rig - Purdue U. 1955 - Surplus from a Chicago taxi Co.

My unit came minus the control head and connecting cables so I converted it into an AC powered station rig.

See more quality images of 1940s-50s GE Mobile Radio gear at:

Low-Band High-Band



Receiver 4ER-6B

I used one of these receivers, AC powered, in my first 6M FM station.

See more quality images of 1940s-50s GE Mobile Radio gear at:

Low-Band High-Band

LYNCHBURG (VIRGINIA) AMATEUR RADIO CLUB

4ØF3 NETS

DIRECTORY OF FIXED-FREQUENCY WIDE-BAND FREQUENCY MODULATION NETS
Issue II November 1960

1. The purpose of this directory is to promote the selection of frequencies already in use when establishing a new network of stations using equipment formerly in taxicabs or police cars. PLEASE DO NOT THROW THIS INFORMATION AWAY. You may have no use for it at present, however, present FCC regulations cause much presently used equipment to be obsolete for COMMERCIAL use by the end of 1963. Already this equipment is finding its way into amateur hands at little or no expense. If you have no interest in this type of activity please pass this to someone who might be able to put it to use.

2. Wide band FM uses fixed frequency, crystal controlled receivers and transmitters. Crystals are expensive, so it is very wise to make a good selection at the beginning. Once established, it is very difficult to get a net moved to a new channel. Thought should be given to the selection, not only in terms of the local operation, but in the light of frequencies used within reasonable driving distances since usually over half of the units are mobiles. Multi-frequency operation is usually possible with simple modifications. This allows the use of 2,3, or more frequencies within reasonable limits (280 kc on six, 720 kc on two) without problems of power output/tube dissapation and loss of receiver sensitivity. Even though multi-frequency operation is possible, it is highly suggested that the primary channels listed below be the channel with the most activity due to the roving mobile passing through your area.

3. SUGGESTED FREQUENCIES: We heartily suggest the use of a frequency that is already in significant use. For six meters, 52.525 mc is by far the leader in use. It is believed that there are as many stations on this frequency as there are on all other six meter FM frequencies combined. It is presently used in at least 9 states and is spreading rapidly. Front end overloading of TV receivers on Channel 2 is minimized by use of this frequency. The second choice would be a presently used channel in the RACES segment (53.35-53.75). For two meters, where there are few TVI problems, there are primary channels in both RACES segments. In the lower segment (145.17-145.71) the primary channel is 145.26 mc. In the upper segment (146.79-147.33) the primary channel is 147.30 mc. It is well worthy of note that Technicians and Novices can operate on 145.26 since it is within their 145-147 requirement. In the unlikely event of new channels being established it is suggested that they be placed at multiples of 40 kc on six meters and 60 kc on two meters from the above listed primary channels. (Example: 53.60, 53.64, 145.26, 145.50) Give your frequency wide publicity (be sure we get it for the next issue).

4. Deviation: We suggest + or — 15 kc, as this is the amount for which the equipment was designed.

5. The authors/editors (K4ZAD, W4DLA, W4DYE, W4PDX) accept no responsibility for the accuracy or completeness of the information in this directory. We would appreciate any corrections or additional data. Please send to T. A. McKee, K4ZAD, 508 Oakridge Blvd., Lynchburg, Virginia. It is expected that Issue III will published about May 1961, however, information should be sent as soon as possible. This directory may be reproduced without further permission, however, credit will be appreciated.

Listing of a city in CAPITAL LETTERS indicates that this frequency has more extensive amateur use in that area, whereas listing in small letters indicates that the use of the frequency in that area is more limited or for a specific purpose, such as nets between CD control centers, so-called private channels, etc.

In some areas two frequencies are used together so that a well located base station may, if it chooses, repeat the signals on one frequency on the other frequency so as to extend the overall range. In this type of system use is made of single frequency receivers and two frequency transmitters so that mobiles may talk directly or with the aid of the repeater. In this listing the frequency upon which the mobile transmits but does NOT listen is indicated thusly: " (Rpt Rcvr to_____mc) "

FREQ	LOCATION	# CALLS	LIAISON	NOTES
52.525 mc	OLD GREENWICH, CONN.	?	?	
	GREATER CHICAGO, ILL.	6	W9QBH	
	ANGOLA, IND.	15	K1CMT/9	
	ELKHART, IND.	3	K9DOF	
	FORT WAYNE, IND.	20	W9PRO	
	HUNTINGTON, IND.	5	W9INV	
	INDIANPOLIS, IND.	25	W9KYU	
	CEDAR RAPIDS, IOWA	?	?	
	LAFAYETTE, IND.	10	W9KRE	
	BATTLE CREEK, MICH.	?	K8GOQ	
	BENTO HARBOR, MICH.	5	K8JMA	
	KALAMAZOO, MICH.	16	K8AFJ	
	GREATER ST. LOUIS, Mo.	3	WØPYS	
	KENTON, OHIO	2	K8ANT	
	SALT LAKE CITY, UTAH	?	?	
	LYNCHBURG, VIRGINIA	6	W4DYE	
	RICHMOND, VIRGINIA	8	W4DXC	
52.530	CLEVELAND, OHIO	7	W8AZO	Exact frequency unknown& may move to 52.525?
52.580	SYRACUSE, N.Y.	7	K2KZL	(see also 53.75)
	TROY, N.Y.	14	W2KLZ	"
	PROVIDENCE, R.I.	4	?	
	Lynchburg, Va.	3	W4DYE	Little Use
52.640	Kalamazoo, Mich.	?	K8AFJ	Second Channel
	Angola, Ind.	?	K1CMT/9	" "
53.000	SAN ANTONIO, TEXAS	9	W5LVE	
53.098	Portland, Ore.	2	W7VS	Point-to-Point
	Seattle, Wash.	2	W7FNO	" "
53.290	OLYMPIA, WASH.	63	W7UVH	
53.440	Onondaga County, N Y	12	K2JIM	CD
53.480	AUBURN, N.Y.	?	K2AJV	CD
53.560	Milwaukee, Wisc.	8	?	CD
53.600	LOUISVILLE,KY.	20	W4BAZ	
	DUPAGE COUNTY, ILL.	?	?	
	Onondaga County, N.Y.	8	K2JIM	CD Second Channel

FREQ	LOCATION	# CALLS	LIAISON	NOTES
53.62	State of Ohio	?	W8ITR	State CD Control Net
53.64	MINNEAPOLIS, MINN.	50	KØGTT	
53.72	Portland, Ore.	2	W7VS	Point-to-point net
53.74	Milwaukee, Wisc.	8	?	CD
53.75	Syracuse, N.Y.	7	K2KZL	(Rpt Rcvr to 52.58 mc)
	Troy, N.Y.	14	W2KLZ	(Rpt Rcvr to 52.58 mc)
144.70	Seattle, Wash.	?	W7FNO	DX
145.17	Portland, Ore.	14	W7VS	RACES
145.20	State of Ohio(Westerville)	?	?	State CD
	SAN ANTONIO, TEXAS	?	W5LVE	
	LONGMONT, COLO.	?	?	
	BALTIMORE, MD.	?	?	CD
	DETROIT, MICH.	?	?	
	Cleveland, Ohio	?	W8ITR	CD
145.26	LYNCHBURG, VIRGINIA	43	W4DYE	(see also 145.68 mc)
	SYRACUSE, N.Y.	20	W2AMY	
	COLUMBUS, OHIO	35	W8OQT	
	WORTHINGTON, OHIO	?	W8RSY	CD
	WESTERVILLE, OHIO	?	?	State CD
	WASHINGTON, D C AREA	?	W4ZAW	
	NORFOLK, VA	?	KN4WKI	
	AMHEARST, VA	?	W4MXH	(see also 145.68)
	ROANOKE, VA	?	K4ZAD or K4UMK	(see also 145.68)
	DETROIT, MICH.	?	?	RACES
	OTTAWA COUNTY, OHIO	?	?	
145.32	Baltimore, Md	?	?	CD
145.35	Birmingham, Ala.	?	?	CD
	Milwaukee, Wisc	12	?	CD
145.38	TOLEDO, OHIO	?	K8DPE	
145.44	BOISE, IDAHO	50	W7OL	
145.50	MEMPHIS, TENN.	?	?	
	Milwaukee, Wisc.	6	?	CD Portable Units
145.53	Milwaukee, Wisc	12	?	CD
145.59	UTICA, N Y	15	W2SSL	CD
145.68	Lynchburg, Virginia Area	43	W4DYE	(Rpt Rcvr to 145.26 mc)
	Amherst,Va	?	W4MXH	
	Roanoke, Va.	?	see 145.26	

FREQ	LOCATION	# of CALLS	LIAISON	NOTES
146.76	SEATTLE, WASH.	110	W7YKA	
	Boise, Ida.	?	?	
	COQOUILLE , ORE.	?	?	
	Los Angeles, Calif	?	?	
	San Diego, Calif	?	?	
146.82	Seattle, Wash.	?	W7FNO	RACES
146.88	Seattle, Wash.	?	W7FNO	RACES
146.90	QUINCY, ILL.	?	K9KCY	CD
	Toledo, Ohio	6	K8DPE	
146.94	CHICAGO,ILL. AREA	?	K9OJV	
	ANNE ARUNDEL COUNTY,MD.	10	W3NAE	
	Seattle, Wash.	?	W7FNO	CD
	Milwaukee, Wisc.	8	?	CD
146.97	Chicago, Ill.	3	K9OJV	
	DALLAS, TEXAS	?	K5MYG	
146.98	ROANOKE, VA.	5	K4UMK	
147.00	Milwaukee, Wisc.	6	?	CD Portable Units
147.06	Chicago, Ill.	?	K9OJV	CD Control Center Net
147.18	(CHICAGO AREA)	?	K9OJV	Proposed move from 147.50
	Pittsburg, Pa.	48	W3UGV	CD Portable Units
	Milwaukee, Wisc.	8	?	CD
147.24	CHICAGO SUBURBS	?	K9OJV	
	Cleveland, Ohio	?	W8ITR	CD Control Center Net
	St. Louis, Mo.	?	?	RTTY
147.30	CHICAGO ILL. AREA	?	K9OJV	
	NORTHWESTERN INDIANA	100	W9EHZ	RACES
	CENTRAL INDIANA	100	K9KRE	
	LOUISVILLE, KY.	30	W4BAZ	
	Detroit, Mich.	?	?	
	Columbus,Ohio	1	W8RSY	CD/Public Serv Interconnect
	St. LOUIS ,MO.	?	?	
	Cleveland, Ohio	3	W8GMS	CD Control Center Net
	Anne Arundel County Md.	3	W3NAE	CD Portable Units
	Appleton, Wisc	?	?	
	CHAMPAIGN, ILL	?	?	
147.40	Chicago Ill.	6	K9OJV	
147.50	CHICAGO, ILL.	100/	W9LLZ	May move to 147.18
147.60	Chicago, Ill	?	K9OJV	
	PORTSMOUTH, VA	5	K4STE	May move to 145.26
147.70	Chicago, Ill	12	K9OJV	RTTY

FM NETS

DIRECTORY OF FIXED FREQUENCY WIDE-BAND FREQUENCY MODULATION AMATEUR NETWORKS

Issue 3 June 1961

1. The purpose of this directory is to promote the selection of frequencies already in use when establishing a new network of stations using equipment formerly in taxicabs or police cars. PLEASE DON'T THROW THIS INFORMATION AWAY. You may have no use for it at present, however, present FCC regulations cause much presently used equipment to be obsolete for commercial use by the end of 1963. Already this equipment is finding its way into amateur hands at little or no expense. If you have no interest in this type of activity please pass this to someone who might be able to put it to use.

2. Wide-band FM uses fixed frequency crystal controlled receivers and transmitters. Crystals are expensive, so it is very wise to make a good selection at the beginning. once established, it is very difficult to get a net moved to a new channel. Thought should be given to the selection, not only in terms of local operation, but in the light of frequencies used within reasonable driving distances since usually over half of the units are mobiles. Multifrequency operation is usually possible with simple modifications. This allows the use of 2, 3, or more frequencies within reasonable limits (280 kc on six, 720 kc on two) without problems of power output/tube dissapation and loss of receiver sensitivity.

3. SUGGESTED FREQUENCIES:

NATIONAL WIDE-BAND FM CALLING AND WORKING FREQUENCIES
52.525 Mc 146.94 Mc

On six we heartily suggest the use of 52.525 Mc. This frequency is by far the leader in usage. It is believed that there are as many stations on this frequency as there are on all other six meter FM frequencies combined. It is presently used in at least 12 states and is spreading rapidly. Front end overloading of TV receivers on Channel 2 is minimized by the use of this frequency. Other suggested six meter channels are as follows: 52.64 Mc for the second channel, 52.72 Mc for the third channel, and 52.60 Mc for FM audio shift RTTY as is presently used in several areas. For two meters, it is increasingly apparent to the editors of this directory that the people starting new FM nets are generally picking frequencies in the region just below 147 mc. Their reasoning is sound, as these frequencies are within the RACES band and also in the Technician(& Novice) segment. In order to promote a realistic national two meter FM frequency we are suggesting the use of 146.94 Mc as a national FM Calling (& Working in single frequency areas) frequency. Although we in the Lynchburg,Va. area have over 225 crystals for our 145 Mc frequencies, we urge that new nets pick 146.94 Mc as their first activated frequency, and that existing nets pick 146.94 as a second frequency where technically possible. ALL NETS on two should equip at least one station on 146.94 mc for the roving mobiles. It will be noted that 146.94 is in keeping with the desire of placing channels on 60 kc increments in the 146.76 to 147.30 range. PLEASE NOTE that we are NOT suggesting an all encompassing change of crystals to go to the new frequency, we are only asking that existing nets actively support the use of this frequency by picking it as a second channel and by cooperating in an effort to obtain its listing in QST & CQ as a national FM frequency as shown in the box above and explained in the next paragraph.

4. QST & CQ LISTING OF NATIONAL FM FREQUENCIES. By cooperation of the present FM users, we should be able to obtain the listing of national FM calling and working frequencies (one in each band). The main advantage of this is a monthly reminder of suggested FM frequencies to persons just becoming interested in FM in a new area. This listing would be similar to the RTTY listing now carried in the Operating News section of QST. WRITE YOUR ARRL DIRECTOR, ARRL HQ, & EDITOR OF CQ SUGGESTING THAT 52.525 & 146.94 BE LISTED AS THE NATIONAL FM CALLING & WORKING FREQUENCIES. Individual letters or cards are better than group letters or petitions. Remember, that only by cooperation can we obtain a listing of this type as we understand that ARRL will not list any frequency unless there is almost unanimous agreement as to the frequency to be listed. If very many cards are received by ARRL suggesting other frequencies they will not list ANY FM frequency. This will injure ham FM in the long run. Although the picture looks bright on six, it will take some time to achieve a truly nationwide two meter FM frequency, both designated and used, however now is the time to get it designated so that new nets can get started on it and thus making the transistion as painless as possible.

5. Listing of a city in CAPITAL LETTERS indicates that this frequency has more extensive general amateur usage in that area, whereas listing in small letters indicates that the use of the frequency in that area is more limited or for a specific purpose, such as nets between CD control centers, so-called "private channels", etc.

6. This directory is automatically sent to all liaison stations. In return, we expect the listed liaison to keep us posted on the status of FM activity in his area. If we do not receive information from a given liaison, we will attempt to locate a new liaison in that area.

7. DEVIATION: Although it appears nearly everyone is using 15 kc deviation, we felt that we should mention it for the record.

8. AREA CONCEPT: Since radio signals dont recognize political subdivisions and extend over a general area, we have attempted to list activity on an area basis. For example, we do not list surburbs unless there is no similar activity in the nearby major city. Arbitrarily we have selected about 25 to 40 miles as a radius limit to an area for the purposes of this list. Naturally there are exceptions to be found. Please try to report activity on this basis.

9. The authors/editors (K4ZAD, W4DYE, & W4PDX) accept no responsibilty for the accuracy or completeness of the information in this directory. We would appreciate any corrections or additional data. Please send to T. A. McKee, K4ZAD, 1306 Grove Road, Lynchburg, Va. (NOTE NEW ADDRESS) The printing of this directory is thru the courtesy of K9DOF in Elkhart, Ind. It is expected that issue IV will be published about Jan. 1962, however information should be sent as soon as possible. This directory may be reproduced without further permission.

10. REPEATERS: In some areas two frequencies are used together so that a well located base station may, if it chooses, repeat the signals on one frequency on the other frequency so as to extend the overall range. In this type of system use is made of single frequency receivers and two frequency transmitters so that mobiles may talk directly or with the aid of the repeater. In this listing the frequency upon which the mobile transmitts but does NOT listen is indicated thusly: "Rpt Rcvr to ±_____ Mc.

The five pages of net data which followed are omitted

NATIONAL WIDE-BAND FM CALLING AND WORKING FREQUENCIES

52.525 Mc 146.94 Mc

F M NETS

A DIRECTORY OF FIXED FREQUENCY WIDE-BAND FREQUENCY MODULATION AMATEUR NETWORKS

ISSUE 4 — JULY 1962

-- THE BOX SCORE --

NUMBER OF STATES ON

52.525 Mc	146.94 Mc
23	15

1. PURPOSE: The purpose of this directory is to promote the orderly selection of frequencies when establishing a new network of amateur stations using equipment formerly in taxicabs or police cars.

2. GENERAL: Wide-band FM uses fixed frequency, crystal controlled, receivers and Xmtrs. Crystals are expensive, so it is very wise to make a good frequency selection at the beginning. Once established it is difficult to get a net moved to a new channel. Thought should be given to the selection, not only in terms of local operation, but also in the light of frequencies used within reasonable driving distances since usually over half of the units are mobiles. Multifrequency operation is usually possible with simple modifications. This allows the use of 2, 3, or more frequencies within reasonable limits (280 Kc on six, 720 Kc on two) without problems of power output/tube dissipation and loss of receiver sensitivity. Somewhat greater spacings are possible if you are willing to accept the small losses in performance.

3. NATIONAL CALLING AND WORKING FREQUENCIES FOR FM: Usage of 52.525 Mc and 146.94 Mc as common national FM channels is picking up. In order to achieve a truly nationwide status for these frequencies, new nets should pick these frequencies as their first activated frequencies and all stations presently using FM should plan on eventually adding these frequencies to their units as second channels etc. Of course these National Wide-Band FM Calling and Working Frequencies will probably be used in different manners in different areas. In a large metropolitan area with over a hundred mobiles they may be calling frequencies only, with stations switching to other channels for working. In a small town with only 5 or 10 units they will probably be the only channels in use. In areas with 15 to 50 units they may be used as calling and short conversation frequencies with stations switching to other channels for longer conversations and rag chews. Correspondence from the ARRL indicates that they are aware of the growth of FM and are considering the listing in QST each month of 146.94 and 52.525 Mc as nationwide FM frequencies. If you have not written to the ARRL (W1BDI) in support of the listing of these frequencies in QST please do so. Your letter is important.

4. SELECTION OF OTHER FREQUENCIES: In most areas the National Wide-Band FM Calling and Working Frequencies are not going to be sufficient to carry all the traffic which FM will carrying in a few years. In these areas other channels are going to have to be selected and used in order to provide a workable FM system for the area. It is important that we begin following a frequency channelizing plan which will allow the maximum number of channels within the frequency switching range of the equipment. If this is not done we are soon going to find that the demand for channels exceeds the available spectrum space. Here we can take advantage of the experience of the commercial users of FM equipment. The old wide band commercial FM systems used 40 Kc. channel spacing on frequencies near 6M and 60 Kc. channel spacing of frequencies near 2M. It is true that some of the very old gear which hams are using will not work adequately at these spacings, and also that some of the newer gear may be bothered by an occasional squelch opening (particularly if modulation limiters are not used in the Xmtrs) at these frequency spacings. For these reasons only every other 40 Kc. (6M) or 60 Kc. (2M) channel should be used in any given area. This will allow us to come back later and fill in the usused channels as the demand for channels grows and as the general run of FM equipment in ham service improves. Some areas have been following frequency usage plan like this for several years, and it is these channels which we are suggesting here. Uniform channel spacing is maintained except between 52.525 and 52.56 where the spacing is only 35 Kc. In this directory these suggested channels are shown in bold print for frequencies near 146.94 and 52.525 Mc.

FM NETS ISSUE 4 JULY 1962

FM NETS is published approximately once each year by K4ZAD, W4DYE & K4FSU. The printing of this issue of FM NETS is thru the courtesy of W4BLD in Waynesboro, Va. Every attempt is made to make the information given as accurate and as complete as is possible. However, the authors/editors accept no responsibility for errors or omissions. We would appreciate any corrections or additional data. All mail for this publication should be sent to: T. A. McKee, K4ZAD, 1306 Grove Rd., Lynchburg, Va. (Phone-239-5002) This directory may be reproduced without further permission.

5. STANDARDS: The use of 15 Kc deviation and vertical antennas for Ham FM has become so universal that they should be considered to be standards for Ham FM systems.

6. REPEATERS: In some areas two frequencies are used together so that a well located base station may, if it chooses, repeat the signals on one frequency on the other frequency so as to extend the overall range. In this type of system use is made of single frequency receivers and two frequency transmitters so that mobiles may talk directly or with the aid of the repeater. In this listing the frequency upon which the mobile transmitts but does NOT listen is indicated thusly: Rpt Rcvr to _____ Mc.

7. METHOD OF LISTING: At the urging of several of you who have written us, we are changing the method of listing activity in this directory from the area method, which we have previously used, to a system which will list the largest city with activity within a given county. Only one city per county will be listed for a given frequency. If you are a liaison station please try to report activity by counties. Of course, we would also appreciate hearing about any FM activity which you may know of in areas other than your own. The listing of a city in CAPITAL LETTERS indicates that this frequency has more extensive general amateur usage in that area, whereas listing in small letters indicates that the use of the frequency in that area is more limited or for a specific purpose, such as nets between CD control centers, so-called "private channels", etc.

8. RECIPROCITY: This directory is automatically sent to all liaison stations. In return we expect the listed liaison to keep us posted on the status of FM activity in his area. If we do not receive information from a given liaison, we will attempt to locate a new liaison in that area.

9. ADDITIONAL COPIES: Additional copies of this directory may be obtained by writing to the address shown in the box above. Please enclose postage to cover your request. A stamped, self-addressed, business size envelope is fine for a single copy.

10. FM NEWSLETTER: K4FSU is planning to publish a bimonthly FM newsletter. This newsletter will serve as a means of exchanging technical and nontechnical information on hamband FM. Included from time to time will be corrections and additions to this directory. The newsletter will consist mainly of letters, articles, etc. submitted by you. If it is possible for you to do so please submit your material for the FM News on RTTY tape. This will allow us to cut a hecto master directly from your tape and will save us much work in getting the bulletin out. No payment will be made for anything published in the FM News. The first issue will be published in a couple of months. The subscription rate is 25¢ for the first 6 issues. Subscriptions and all correspondence for the FM News should be sent to: Seymour Paul Jr., K4FSU, Rt. 2, Waterlick Rd., Lynchburg, Va.

11. CONVERSION BOOK: The first conversion book covering Ham FM gear has recently been completed by K9OJV and K9YHQ. This book is mentioned here because it is the first of its kind. The book covers Motorola 2 Meter gear only. The information presented is quite complete, and the book includes schematics of many of the older Motorola chassis. The price is $1.75. The book is available from J.S. Aagaard, c/o Electrical Engineering Dept., 2145 Sheridan Rd., Evanston, Ill.

The 11 pages of net data which follow are omitted

XXXXXXXXXXXXXXXXXXXXXXXXX

X NATIONAL WIDE-BAND FM X
X CALLING AND WORKING X
X FREQUENCIES X
X 52.525 MC 146.94 MC X

XXXXXXXXXXXXXXXXXXXXXXXXX

- FM NETS -

A DIRECTORY OF FIXED FREQUENCY WIDE-BAND FM AMATEUR NETWORKS

ISSUE 5 - MARCH 1964

XXXXXXXXXXXXXXXXXXXXXXXXX

X --- THE BOX SCORE --- X
X NUMBER OF STATES ON X
X 52.525 MC 146.94 MC X
X 33 27 X

XXXXXXXXXXXXXXXXXXXXXXXXX

1. PURPOSE: THE PURPOSE OF THIS DIRECTORY IS TO PROMOTE THE ORDERLY SELECTION OF FREQUENCIES WHEN ESTABLISHING A NEW NETWORK OF AMATEUR STATIONS USING EQUIPMENT FORMERLY IN TAXICABS OR POLICE CARS. A SECONDARY PURPOSE IS TO PROVIDE THE TRAVELING OR DXING HAM WITH INFORMATION ON THE USE OF VHF FM IN AREAS OTHER THAN HIS OWN.

2. GENERAL: WIDE-BAND FM USES FIXED FREQUENCY, CRYSTAL CONTROLLED, RECEIVERS AND XMTRS. CRYSTALS ARE EXPENSIVE, SO IT IS VERY WISE TO MAKE A GOOD FREQUENCY SELECTION AT THE BEGINNING. ONCE ESTABLISHED IT IS DIFFICULT TO GET A NET MOVED TO A NEW CHANNEL. THOUGHT SHOULD BE GIVEN TO THE SELECTION, NOT ONLY IN TERMS OF LOCAL OPERATION, BUT ALSO IN THE LIGHT OF FREQUENCIES USED WITHIN REASONABLE DRIVING DISTANCES SINCE USUALLY OVER HALF OF THE UNITS ARE MOBILES. MULTI FREQUENCY OPERATION IS USUALLY POSSIBLE WITH SIMPLE MODIFICATIONS. THIS ALLOWS THE USE OF 2, 3, OR MORE FREQUENCIES WITHIN REASONABLE LIMITS (280 KC ON SIX, 720 KC ON TWO) WITHOUT PROBLEMS OF POWER OUTPUT/TUBE DISSIPATION AND LOSS OF RECEIVER SENSITIVITY. SOMEWHAT GREATER SPACINGS ARE POSSIBLE IF YOU ARE WILLING TO ACCEPT THE SMALL LOSSES IN PERFORMANCE.

3. NATIONAL CALLING AND WORKING FREQUENCIES FOR FM: USAGE OF 52.525 MC AND 146.94 MC AS COMMON NATIONAL FM CHANNELS IS RAPIDLY PICKING UP. THE FM FREQUENCY LISTING IN QST IS HELPING GREATLY HERE. IN ORDER TO ACHIEVE A TRULY NATIONWIDE STATUS FOR THESE FREQUENCIES, NEW NETS SHOULD PICK THESE FREQUENCIES AS THEIR FIRST ACTIVATED FREQUENCIES AND ALL STATIONS PRESENTLY USING FM SHOULD PLAN ON EVENTUALLY ADDING THESE FREQUENCIES TO THEIR UNITS AS SECOND CHANNELS ETC. OF COURSE THESE NATIONAL WIDE-BAND FM CALLING AND WORKING FREQUENCIES WILL PROBABLY BE USED IN DIFFERENT MANNERS IN DIFFERENT AREAS. IN A LARGE METROPOLITIAN AREA WITH OVER A HUNDRED MOBILES THEY SHOULD BE CALLING FREQUENCIES ONLY, WITH STATIONS SWITCHING TO OTHER CHANNELS FOR WORKING. IN A SMALL TOWN WITH ONLY 5 OR 10 UNITS THEY WILL PROBABLY BE THE ONLY CHANNELS IN USE. IN AREAS WITH 15 TO 50 UNITS THEY MAY BE USED AS CALLING AND SHORT CONVERSATION FREQUENCIES WITH STATIONS SWITCHING TO OTHER CHANNELS FOR LONGER CONVERSATIONS AND RAG CHEWS.

4. SELECTION OF OTHER FREQUENCIES: IN MOST AREAS THE NATIONAL WIDE-BAND FM CALLING AND WORKING FREQUENCIES ARE NOT GOING TO BE SUFFICIENT TO CARRY ALL THE TRAFFIC WHICH FM WILL BE CARRYING IN A FEW YEARS. IN THESE AREAS OTHER CHANNELS ARE GOING TO HAVE TO BE SELECTED AND USED IN ORDER TO PROVIDE A WORKABLE FM SYSTEM FOR THE AREA. IT IS IMPORTANT THAT WE BEGIN FOLLOWING A FREQUENCY CHANNELIZING PLAN WHICH WILL ALLOW THE MAXIMUM NUMBER OF CHANNELS WITHIN THE FREQUENCY SWITCHING RANGE OF THE EQUIPMENT. IF THIS IS NOT DONE WE ARE SOON GOING TO FIND THAT THE DEMAND FOR CHANNELS EXCEEDS THE AVAILABLE SPECTRUM SPACE. HERE WE CAN TAKE ADVANTAGE OF THE EXPERIENCE OF THE COMMERCIAL USERS OF FM EQUIPMENT. THE OLD WIDE BAND COMMERCIAL FM SYSTEMS USED 40 KC CHANNEL SPACING ON FREQUENCIES NEAR 6M AND 60 KC CHANNEL SPACING ON FREQUENCIES NEAR 2 M. IT IS TRUE THAT SOME OF THE VERY OLD GEAR WHICH HAMS ARE USING WILL NOT WORK ADEQUATELY AT THESE SPACINGS, AND ALSO THAT SOME OF THE NEWER GEAR

FM NETS ISSUE 5 MARCH 1964
FM NETS IS PUBLISHED APPROXIMATELY ONCE A YEAR BY K4ZAD, K4FSU, & W4DYE. EVERY ATTEMPT IS MADE TO MAKE THE INFORMATION GIVEN AS ACCURATE AND AS COMPLETE AS IS POSSIBLE. HOWEVER, THE EDITORS ACCEPT NO RESPONSIBILITY FOR ERRORS OR OMISSIONS. WE WOULD APPRECIATE ANY CORRECTIONS OR ADDITIONAL DATA. MAIL ADDRESS: T. A. MCKEE, K4ZAD, 1306 GROVE RD., LYNCHBURG, VA. 24502 (PHONE 703-239-5002) THIS DIRECTORY MAY BE REPRODUCED WITHOUT FURTHER PERMISSION.

MAY BE BOTHERED BY AN OCCASIONAL SQUELCH OPENING (PARTICULARLY IF MODULATION LIMITERS ARE NOT USED IN THE XMTRS) AT THESE FREQUENCY SPACINGS. FOR THESE REASONS ONLY EVERY OTHER 40 KC (6M) OR 60 KC (2M) CHANNEL SHOULD BE USED IN ANY GIVEN AREA. THIS WILL ALLOW US TO COME BACK LATER AND FILL IN THE USUSED CHANNELS AS THE DEMAND FOR CHANNELS GROWS AND AS THE GENERAL RUN OF FM EQUIPMENT IN HAM SERVICE IMPROVES. SOME AREAS HAVE BEEN FOLLOWING A FREQUENCY USAGE PLAN LIKE THIS FOR SEVERAL YEARS, AND IT IS THESE CHANNELS WHICH WE ARE SUGGESTING HERE. UNIFORM CHANNEL SPACING IS MAINTAINED EXCEPT BETWEEN 52.525 AND 52.56 MC. IN THIS DIRECTORY THESE SUGGESTED CHANNELS ARE SHOWN BY THE $ SYMBOL FOR FREQUENCIES NEAR 146.94 AND 52.525 MC. POPULAR FREQUENCIES ON THESE CHANNELS ARE AS FOLLOWS: 52.525, 52.60(6M RTTY), 52.64, 52.72, 146.34 (RPT. RCVR. TO 146.76 OR 146.94), 146.70(2M RTTY), 146.76(WEST), 146.94, & 146.30(MIDWEST).

5. 450 MC FREQUENCIES: THE USE OF FREQUENCIES IN THE 440-450 MC REGION FOR GENERAL NET TYPE ACTIVITIES IS GROWING, AND WE HAVE HAD SEVERAL REQUESTS FOR FREQUENCY INFORMATION. 448.8. 449.00, 449.10, & 449.50 ARE IN USE AT THIS TIME. PERHAPS 100 KC CHANNELS WOULD BE A GOOD CHOICE IN THIS BAND. THIS WOULD MAKE ALL THE ABOVE FREQUENCIES FALL ON CHANNELS. WE BELIEVE THAT IT IS A LITTLE EARLY TO PICK A NATIONAL FREQUENCY FOR THIS BAND, BUT THOUGHT SHOULD BE GIVEN TO KEEPING IT A LITTLE LOWER IN THE BAND TO PERMIT TWO FREQUENCY OPERATION ON EITHER SIDE OF IT. SOMETHING LIKE 448.00 OR 448.50 MIGHT BE GOOD? COMMENTS ON THIS ARE WELCOME.

6. STANDARDS: THE USE OF 15 KC DEVIATION (MAXIMUM) & VERTICAL ANTENNAS FOR HAM FM HAVE BECOME SO UNIVERSAL THAT THEY SHOULD BE CONSIDERED TO BE STANDARDS FOR HAM FM SYSTEMS.

7. REPEATERS: IN SOME AREAS TWO FREQUENCIES ARE USED TOGETHER SO THAT A WELL LOCATED BASE STATION MAY, IF IT CHOOSES, REPEAT THE SIGNALS ON ONE FREQUENCY ON THE OTHER FREQUENCY SO AS TO EXTEND THE OVERALL RANGE. IN THIS TYPE OF SYSTEM USE IS MADE OF SINGLE FREQUENCY RECEIVERS AND TWO FREQUENCY TRANSMITTERS SO THAT MOBILES MAY TALK DIRECTLY OR WITH THE AID OF THE REPEATER. IN THIS LISTING THE FREQ. UPON WHICH THE MOBILE TRANSMITS BUT DOES NOT LISTEN IS INDICATED THUSLY: RPT RCVR TO XXX.XX MC.

8. METHOD OF LISTING: THIS DIRECTORY ATTEMPTS TO LIST THE LARGEST CITY WITH ACTIVITY WITHIN A GIVEN COUNTY. ONLY ONE CITY PER COUNTY WILL BE LISTED FOR A GIVEN FREQUENCY. IF YOU ARE A LIAISON STATION PLEASE TRY TO REPORT ACTIVITY BY COUNTIES. OF COURSE, WE WOULD ALSO APPRECIATE HEARING ABOUT ANY FM ACTIVITY WHICH YOU MAY KNOW OF IN AREAS OTHER THAN YOUR OWN. THE PERSON SENDING US THE LATEST INFORMATION IS GENERALLY LISTED AS THE LIAISON STATION. (CONTINUED ON PAGE 17)

FREQ MC	LOCATION	NR OF CALLS	LIAISON	NOTES
147.33 MC	VANCOUVER,B.C. CAN.	70?	VE7IR	
	VICTORIA, B.C. CAN.	?	?	
147.35 MC	LOS ANGELES, CAL.	?	K6UIG	
147.40 MC	CHICAGO, ILL.	6?	K9OJV	
	DETROIT, MICH.	?	?	RTTY
147.42 MC	LOS ANGELES, CAL.	?	WA6EJI	SEE ALSO 146.94
147.50 MC	CHAMPAIGN, ILL.	?	?	
	CHICAGO, ILL.	100?	W9LLZ	
	CEDAR RAPIDS,IOWA	9	WØQLU	SECOND CHANNEL
	DES MOINES, IOWA	6	WØQNO	CD
147.60 MC	CHICAGO, ILL.	?	K9OJV	
147.70 MC	CHICAGO, ILL.	12	K9OJV	RTTY LITTLE USE
147.71 MC	SAN JOSE, CAL.	11	WA6YCZ	SEE ALSO 146.85
147.85 MC	VACAVILLE, CAL.	15?	W6IJY	SEE ALSO 144.20
147.96 MC	HAMILTON,ONT. CAN.	25	VE3EWW	NOT USABLE IN USA

9. RECIPROCITY: THIS DIRECTORY IS AUTOMATICALLY SENT TO ALL LIAISON STATIONS. IN RETURN WE EXPECT THE LISTED LIAISON TO KEEP US POSTED ON THE STATUS OF FM ACTIVITY IN HIS AREA. IF WE DO NOT RECEIVE INFORMATION FROM A GIVEN LIAISON, WE WILL TRY TO LOCATE A NEW LIAISON IN THAT AREA.

10. ADDITIONAL COPIES: A FEW ADDITIONAL COPIES OF THIS DIRECTORY MAY BE OBTAINED BY WRITING TO THE ADDRESS SHOWN IN THE BOX ABOVE. PLEASE ENCLOSE POSTAGE TO COVER YOUR REQUEST. A STAMPED, SELF-ADDRESSED, BUSINESS SIZE ENVELOPE IS FINE FOR A SINGLE COPY. IF FIRST CLASS MAILING IS DESIRED 10 CENTS POSTAGE IS NECESSARY. THE TELETYPE TAPES FOR THIS DIRECTORY ARE AVAILABLE TO ANYONE WHO WILL PAY THE POSTAGE AND WHO WILL RETURN THEM WITHIN 30 DAYS. USING THESE TAPES TO MAKE YOUR OWN HECTO MASTERS IS STRONGLY SUGGESTED TO THOSE WHO WANT MORE THAN A FEW COPIES.

11. FUTURE ISSUES OF FM NETS: DUE TO THE RAPIDLY GROWING NUMBER OF LISTINGS FUTURE ISSUES WILL HAVE TO BE SOMEWHAT DIFFERENT. IN FACT, WITHOUT YOUR COOPERATION THERE WILL BE NO FUTURE ISSUES. VOLUNTEERS ARE NEEDED FOR STATE AND/OR AREA COORDINATORS. (VOLUNTEERS PLEASE WRITE) THERE ARE SIMPLY TOO MANY LIAISON STATIONS FOR THE EDITORS TO CONTACT WHEN DATA IS NEEDED. ALSO IT IS DIFFICULT FOR US TO RESOLVE THE DIFFERENCES IN THE DATA WHICH WE RECEIVE AS WE ARE SO FAR FROM SOME OF THE AREAS IN QUESTION. FOR THESE REASONS THE ACCURACY OF THIS ISSUE IS PROBABLY LESS THAN PREVIOUS ISSUES. UNLESS MANY VERY STRONG OBJECTIONS (WITH GOOD REASONS) ARE RECEIVED FUTURE ISSUES WILL LIST ONLY ACTIVITY ON STANDARD CHANNELS (SEE PARA. 4) WITHIN THE FREQUENCY RANGES 52.525 TO 53.04 MC AND 146.00 TO 147.9 MC. ONLY GENERAL USAGE REPEATER SYSTEMS WILL BE LISTED IN FUTURE ISSUES. COMPLEX LIMITED ACCESS REPEATER SYSTEMS WITH MULTIPLE INPUT AND OUTPUT FREQUENCIES WILL NOT BE LISTED.

Pages 3 through 16 (Net data) are omitted

NATIONAL WIDE-BAND FM CALLING AND WORKING FREQUENCIES

52.525 Mc 146.94 Mc

F M NEWS

VOL. 1 NO. 1 SEPTEMBER 1962

-- THE BOX SCORE --
NUMBER OF STATES ON
52.525 Mc 146.94 Mc
23 15

GREETINGS - you are now reading the first issue of a newsletter which is published bi-monthly for the following purposes:

1. Common communication between groups of F.M. enthusiasts.

2. Nationwide coordination of frequencies, uses of same, and compatibility of systems.

3. Presentation of articles, both of general and technical interest that concern F.M.

4. Anything else that will promote the use and quality of V.H.F. - F.M.

At present the "F.M. News" is published by myself (Seymour Paul) and Tom McKee. We both are concerned with F.M. in our work as well as having a great interest in it as a hobby.

The "News" is printed with a mimeograph process. It is non-profit and we will publish a financial statement once a year. Its future will depend on its popularity.

We plan to publish articles which you send us on F.M. Anything from operation to schematics and especially conversion data. If possible this should be on RTTY tape tailored for this size paper. If you have a simpler conversion, etc., than we publish - let us know! In technical articles we hope to keep them both simple and inexpensive so those interested will be able to use them.

FOLLOWING is a list of points on which we need comments from your area. In the next issue we will print an outline of this data and recommend plans to help standardize nationwide F.M. operation. Please give us you opinions and your suggestions.

1. We now have national calling frequencies for each band (52.525/146.94) and a RTTY frequency for six (52.60). We would like to suggest that some thought be given to the establishment of a "long haul" frequency for each band for use whenever minimum interference long distance communications is desired. Generally these frequencies would be used by base stations only. 52.72 and 146.64 might be good choices, comments? How about comments from you on a national two meter RTTY frequency?

2. Is anyone using tone operation to make monitoring easier? What type of system, frequency, etc.?

3. We would like to know the name, address and any details of F.M. equipment sources available to hams.

4. Lists of publications or articles which you have found helpful in ham F.M. work.

5. Any lists of F.M. stations, nets, etc. to help K4ZAD with his "F.M. Nets" will be appreciated.

6. What other F.M. details that we haven't mentioned need to be discussed?

ON the following pages we have a few articles which will give you some idea of what future issues will contain.

73 K4FSU - K4ZAD

FM NEWS VOL. 1, NO. 1 SEPT. 1962

"FM NEWS" is published bi-monthly by K4FSU and K4ZAD. The publication of the "News" is on a strictly non-profit basis. A 25¢ subscription rate covers the cost of paper and postage for six issues. Advertising is not accepted by this publication. Every attempt is made to make the information given as accurate and as complete as possible. However the editors accept no responsibility for any errors. All mail should be sent to: Seymour Paul Jr., K4FSU, Rt. 2, Waterlick Rd., Lynchburg, Virginia. (Phone 703-239-2520) If credit is given to our authors any part of this publication may be reproduced without further permission.

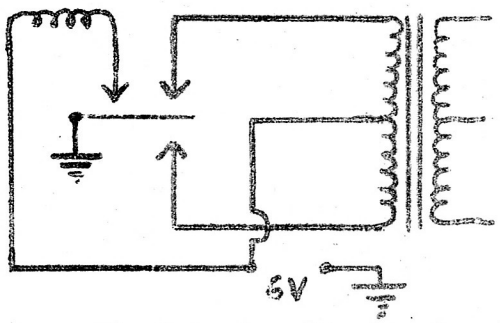
FM PICNIC: The Third Annual Wide-Band FM Picnic held at Angola, Indiana on August 4th was a smashing success. This affair drew 198 people which isn't at all bad when you consider that it is devoted only to ham band FM. Bob Stone, W9JRR of Fort Wayne gave an introductory warm-up talk. The principal speaker was Jim Aagaard, K90JV, of Northwestern University. Jim spoke on the conversion of commercial two-way FM equipment for amateur use, and on multi-channel operation. An impressive list of prize donors contributed quite a nice list of prizes. Milt Flowers, K8NEU, of Edgerton, Ohio was the winner of the grand prize, which was a high band 60 watt GE base station. Ward Taylor, W4CTU/9 was the general chairman of this yeas' picnic. Nextyear the "Fourth Annual Wide-Band FM Picnic" will be held Sunday, August 4, 1963 at Angola, Indiana.

We are sorry but we are unable to report any FM activity from Philadelphia, Pa., one of the nations larges population centers.

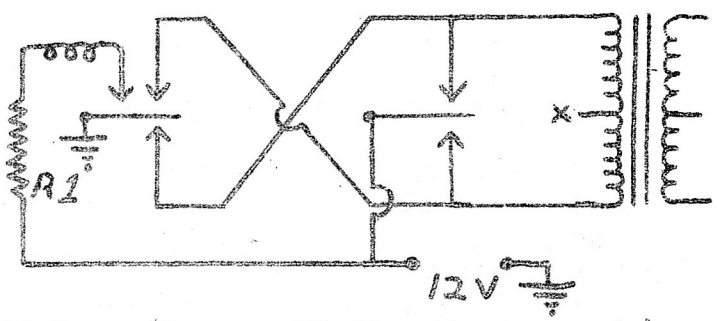
K7USA: Most of you probably know that the World's Fair at Seattle has an operating amateur station, K7USA. However, many of you probably did not know that K7USA is equipped for VHF FM operation. An 80 watt GE rig is used for contacts on 146.76, 146.94 and 147.33. We're doing pretty good when you can get talked into the World's Fair on FM.

CONVERSION TIP: From K4MKO we have a simple kink for converting that 6 volt vibrator power supply to 12 volt operation.

OLD CIRCUIT



NEW CIRCUIT



R1: Select value to give 6 volt drop. (Varies with the vibrator used.)

There may be other types of 6 volt circuits than the one shown. However, the principle still applies. If the original circuit was synchronous, silicon rectifiers may be used in place of the rectifying contacts of the vibrator. The vibrator for the new circuit should be a Mallory type 1701 or a GE type 7141584p3 or equivalent, since both sets of contacts must carry considerable current. Harry is presently using this idea on 6 meters in an RCA unit. The idea also works on broadcast receivers for cars. The filaments must also rewired for 12 volts by the usual methods.

FROM W7VS: In a recent letter W7VS writes of the point-to-point circuits being operated between Portland, Ore., and Seattle, Wash. 53.10 and 146.88 are the frequencies used for this circuit. According to Temple, 1/4 Kw outputs and 7 element six meter and 15 element two meter horizontal beams are used to provide a full quieted signal about 97% of the time. W7KV and W7FNA are at the Seattle end. We are anxious to hear more about this circuit, including information as to how the paths compare on the two bands. How about it Temple?

WILL A PREAMP HELP? You have probably had the same experience that we have had with preamps ahead of 6 or 2 meter FM receivers. Some of you are probably very enthusiastic about your preamp while an equal number have tried one with little or no success. This seems to be the story with preamps, sometimes they help, and sometimes they don't. This has also been our experience but we have found that there is a very good reason for these variations in performance. The reason is called external noise or noise level. If the noise level at your QTH is low the odds are that a preamp will help. On the other hand, if the noise level is high it is almonst a sure thing that a preamp will not help. Armed with this information and a simple test to determine the noise level you can predict what to expect from a preamp. The following will give you an idea of how to go about determining what to expect from a preamp at your location.

A. MEASUREMENTS:
   1. Begin keeping a log of limiter readings on noise only. These readings should be taken on a limiter jack which is not saturated on noise alone. These readings may vary from time to time.
   2. Connect a carbon resistor of an impedance equal to your transmission line impedance in place of your antenna. Note the limiter reading on noise only.

B. WHAT THE MEASUREMENTS MEAN:
   1. If the readings obtained in A-1&2 above are equal or nearly equal for most of the time your reception is limited mainly by the noise generated in the RF amplifier of your receiver. A low noise preamp will improve your ability to receive weak signals.
   2. If the readings in A1 are somewhat higher than the reading obtained in A2 your reception is limited by the external noise level at your location. You will not gain anything by using a preamp ahead of the receiver under these conditions.

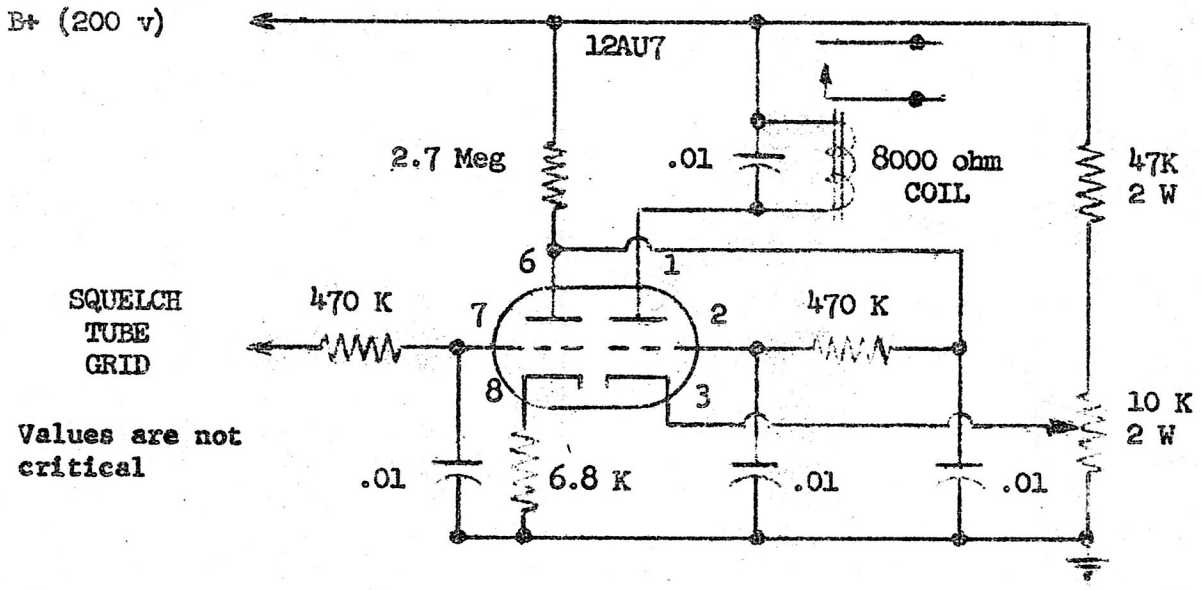
C. WHAT TO DO WITH THE INFORMATION:
   1. If you find by this method that a preamp will help you I would suggest any of the many Nuvistor preamps which have appeared in the magazines over the past year or so.
   2. If you find that your reception is limited by external noise the following may help:
      a. Locate and suppress the noise at its source.
      b. Raise the antenna.
      c. Use a directional antenna.
      d. Look for a new QTH!

D. PREAMP HINTS:
   1. Low noise figures are easier to achieve at 6 meters while the external noise levels are generally higher. This means that it should be easier for you to construct a preamp which will let you see your external noise level at 6 M than it would be at 2 M.
   2. The tests outlined in para. A & B can also be used to tell you how well your pream is working. For example if you repeat the measurements with the preamp on and, the readings with the antenna on and with the resistor on are still nearly equal you can use a better preamp. However when you can see the noise level come up when the anhenna is connected in place of the resistor - STOP. You have done all that you can do with a preamp.

(cont.)

3. One preamp is not better than another just because it gives a higher limiter reading on a fixed input signal. This is an indication of the gain of the preamp, and while some gain is essential for correct preamp operation the really important thing is the noise figure.

THE CARRIER OPERATED RELAY-A SIGNAL ACTUATED SWITCH. Diagramed below is the schematic of a COR, a very handy device for use with any squelch equipped FM receiver. The circuit is designed so that the relay closes when carrier is received by the receiver, and the threshold control is adjusted so as to operate as the squelch circuit opens. The first stage of the tube is normally conducting unless a signal is present, so a negative going voltage should be applied to the first stage as the squelch opens. (Normally to obtain this voltage the input lead to the COR should be connected to the grid of the stage which follows the noise rectifiers in the receiver.) This negative going voltage cuts off the first stage. Since the grid of the second stage is connected to the plate of the first, the second stage conducts drawing current thru the coil and pulling in the relay.



You will probably think of many applications for this COR circuit , and we will be covering several applications of it in future issues of the FM News.

K4QOE - "Where's Mt. Mitchell?"

APOLOGIES: That is about it for this issue. Please excuse our many errors in spelling, typing, etc., and appreciate that this issue was turned out in a hurry so that it could be mailed with FM Nets. You can help us greatly in producing error free masters if you submit your copy on RTTY tape as outlined on the first page. This will greatly lighten our typing load.

IN FUTURE ISSUES: In the next several issues of FM News we will present information on the following.

1. Repeaters and associated problems (including legal)
2. Simple tone calling - Really! - By W4DYE
3. Equipment sources - Ham - Cheap?
4. Home brew deviation monitor - W4GCE tells all.
5. Conversions of various pieces of FM gear.

Use FM the Finer Medium

73 - See you next issue?

NATIONAL WIDE-BAND FM CALLING AND WORKING FREQUENCIES

52.525 Mc 146.94 Mc

F M NEWS

VOL. 1 NO. 2 NOV-DEC 1962

-- THE BOX SCORE --

NUMBER OF STATES ON

52.525 Mc 146.94 Mc

25 17

HERE WE ARE AGAIN - at last! First let's explain a few things. One, bi-monthly means "Occurring, done, or coming, once in two months." (Webster's New Collegiate Dictionary" P 86). The first issue was for September-October and this issue is for November-December. Two, postage rates go up the first of the year and we will have to increase our price slightly for new subscribers.(35¢ per year) Three, there are just the two of us working on the "News" - writing, typing, printing, handling the subscriptions, addressing, mailing, etc. so we may hit a late issue once in a while. But if you miss an issue, let know in a hurry. For the same reasons we will try to give answers to the questions in your letters in the "News" and not write individual letters. Fourth, we can't exchange publications on a regular basis for monetary reasons but will gladly subscribe to any magazine of FM or VHF interest. And fifth, please don't send us long term subscriptions (2 + years).

K4ZAD AND myself feel pretty proud of ourselves....two national ham magazines (73 and VHF HORIZONS) offered to publish the "News" for us and we really appreciate it. But we had to decline both Jim and Wayne because of various restrictions this would place on us and our readers. We also want to thank these folks for their help in spreading the word on FM and hope you-all will let them know how many of us there are in the finer medium portion of the VHF bands.

SUPPORT THE NATIONAL calling frequencies. You as an individual or club can help our effort to standardize. Here are some examples of strong support: In Lynchburg, Va., there were over fifty units on 145.26 Mc. and they had been suggesting this frequency as a national one for a long time - with no headway. After research around the country they found most areas favored the frequencies close to 147 Mc. So 146.94 Mc. looked like the logical channel. About five stations made the initial change one week and soon after the rest followed. We recently received a list of stations on 2M FM in southeastern Michigan and it showed that 28 stations have changed from 146.975 to 146.94 since the FM Picnic in Angola last July.

Now let us make two points, most areas don't have as much to lose as did the above. Why? Because it is likely you can use your old frequency as a second or working channel but Lynchburg was too far away in frequency and Michigan was too close to do this. Second point is the longer you wait to switch the more crystals are bought and the harder it is. So lead the pack and make the switch, you won't be lonely long.....

ANSWERS TO QUESTIONS we asked were plentiful in certain areas and we managed to get enough information to pass along some of it. Our last page has a list of equipment sources and publications which might be helpful. You will find a list of corrections for you "FM Nets" on the next to last page and this will bring you up to date as we are.

As to the response on frequencies, we won't say anything about the national calling frequencies as they are splattered all over, but below are listed the ones we feel sure enough to suggest using:

Alternate or second channel - - 6M 52.640 Mc. and 2M 147.300 or 146.760 Mc.

Long haul or point to point - - 6M 52.720 Mc. and 2M 146.640 Mc.

RTTY - - - - - - - - - - - - - - - 6M 52.600 Mc. and 2M we just can't even guess. RTTY on two FM is scattered all over! (Sorry George)

FM NEWS VOL. I, NO. II NOV/DEC. 1962

"FM NEWS" is published bi-monthly by K4FSU and K4ZAD. The publication of the "News" is on a strictly non-profit basis. A 35¢ subscription rate covers the cost of paper and postage for six issues. Advertising is not accepted by this publication. Every attempt is made to make the information given as accurate and as complete as possible. However, the editors accept no responsibility for any errors. All mail should be sent to: Seymour Paul Jr., K4FSU, Rt. 2, Waterlick Rd., Lynchburg, Va. (Phone 703-239-2520) If credit is given to our authors any part of this publication may be reproduced without further permission.

There is a lot of demand for remote control articles (repeaters). We will very soon satisfy all the questions which you have or use up a lot of paper trying! Within a hundred miles of us we have five of these monsters and so will be able to give you some experienced information.

W4TZI SUGGESTS that we say a little about six meter FM skip. Well, we must admit that it is fun, and we manage to find out about new locations on FM because of it. But someday we will look back to our copy of the FM NEWS that had that article on tone operation (scon) in it and start building up tone gear... till then though I wounder who will be the first to work all states on FM or even sooner who will be first to work all the states that are now on FM? TZI claims 13 worked and 11 confirmed. Any takers?

150 SUBSCRIPTIONS to date and that ain't hay for a group our size. We will do our best to make it worth your time and money to subscribe, and we would appreciate it if you would spread the word about this publication among your local FM gang. While on this point, we have a subscription from KH6EIW in Honolulu, Hawaii and we wish him lots of luck in getting on FM. There are some areas in Canada on Two Meter FM, and VE3EWW sent us their local newsletter which we found interesting. If anyone has the time they might pass along any of these bulletins that have any FM activity mentioned in them.

TONE OPERATION is something that we may be able to standardize before it gets rolling. From our inquiries about the status of tone operation across the country several replies were received, and we found that very little tone operation is going on except to control remote stations. No one indicated that they were using either tone squelch or tone alert type calling, but several indicated that they were thinking along these lines.

A number of frequencies were proposed for tone operation- 600, 1020, 1500, and 2805 cps. A two tone (600, 1500) system was also proposed. The 600, 1500, and 2805 cps frequencies were suggested because of the various commercial tone equipments using these frequencies. The 1020 freq. would make use of surplus FL-5 and FL-8 audio filters as selective elements. Based on what we learned on this first go-around we would make the following suggestions as a start toward standardised tone systems.

A. Use frequencies above 2000 cps for remote control applications. This seems to be compatible with present systems.

B. We suggest tone alert rather than tone squelch operation for Ham FM. This is because the tone alert system can be expanded to individual station calling later.

C. We suggest that amateur FM use single freq. tone operation. The construction of two frequency tone equipment would be more complex than necessary for ham use.

D. Either 1020 or 1500 cps should be used as the standard frequency for tone alert and calling. We need more comments on this. Discussion follows.

The 600 cps frequency has some merit because commercial surplus tone equipment may someday be available. However, for those who could not obtain commercial tone gear it will mean construction of selective elements at 600 cps which would use large values of inductance and capacitance.

The 1020 cps frequency would eliminate the necessity of constructing the selective elements as the FL-5 and 8 are available. However 1020 is not compatible with any commercial gear.

Using 1500 cps would make systems compatible with commercial gear and if the filters had to be constructed, would keep component size to a minimum.

We are working on a simple tone alert system (pulse tone) which will be expandable into a tone calling system later, and will work with any of the above frequencies which may help solve the problem. Details of this system and actual circuitry will be explained in a future issue.

SQUELCH RELAY (COR) - W9IIU wrote and shows a simple way to hook one up. "Connect a 500 to 1000 ohm relay coil in place of the cathode resistor of the audio output stage of the receiver. Lift the ground end of the grid resistor and connect it to a point on the squelch voltage divider (after the noise rectifier) that is negative enough to cut off the tube and drop out the relay on no signal, and that goes to near zero volts with signal. Don't put too big a bypass across the relay coil or it will be a 'slow release'. Telephone type long-spool relays work best." Unquote and thanks Herr Fritz.

ANYONE NEED a modulation limiter for their 30-D Motorola unit? W5VPQ writes that the circuit (which uses no tubes) was published in the September 1949 issue of "Electronics". We will try to get permission to reprint some of it.

A LIST OF MODEL NUMBERS versus frequency, crystal type, power, voltage, etc., is another of our pet projects. But we lack lots of information and if you can send us any for RCA and Link in particular we would appreciate it.

TEN METERS FM has about five nets that are active and all on different frequencies. We would like to point out that most any FM gear that will work on ten will work on six with minor changes and that on the higher frequency the antennas are smaller and that when the skip is in the people on ancient modulation trying to DX won't complain about us taking up all the spectrum.

FREE COPIES of the "News" are sent to various locations from time to time to try and promote interest or to obtain more subscribers.

450 MCS. Anyone for a 450 calling frequency? And along that line the guys who are interested in 450 gear (remote control) can find a good buy at Two-Way Radio Engineers, Roxbury, Mass. (Page 9) Motorola T44A under $50.

VERTICAL ANTENNAS FOR FM are definately a standard according to our correspondence and we definately reccomend their use because of the mobiles and all directional advantages. Plus compatibility with other areas of activity which will someday expand close to you.

FOR OUR MAIN course we have "FM Deviation Monitor", an expansion of an article written by W4GCE for the "Lynchburg Amatuer Radio Club Bulletin", September 1961.

There comes a time when every editor must find a short to fill space. This is called a space filler. This is a space filler.

FM DEVIATION MONITOR By W4CKE: There are various methods available to measure the frequency of FM systems including hetrodyne frequency meters, counters, etc., but the methods for modulation/deviation monitoring are not as plentyful. In areas where there is much FM net activity, it becomes very desirable to have the deviation standardized as well as the frequency. We hope the following info. will help get your net set up for the standard ± 15 Kc. peak deviation.

Calibration of commercial deviation measuring equipment almost always depends on precise mathematical relationships between the division and the audio modulating frequency producing this deviation. These relationships are known as Bessel functions. In an FM system the application of a pure audio tone to the transmitter will cause the carrier to completely disappear at certain deviation settings (Almost like SSB). It is the Bessel functions which give us the exact relationship between these points of carrier null and the deviation and the audio input frequencies.

The formulas which we will be interested in are as follows:

f (dev) = 2.40 f (audio) For the first carrier null

f (dev) = 5.52 f (audio) For the second carrier null

f (dev) = 8.65 f (audio) For the third carrier null

Where:

f (dev) = The deviation in ± Kc.

f (audio) = The audio modulating frequency in Kc.

These formulas worked out for common audio frequencies and deviations yield the following table:

f (audio) (Kc)	f (dev) (± Kc)		
	FIRST CARRIER NULL	SECOND CARRIER NULL	THIRD CARRIER NULL
1.000	2.4	5.52	8.65
2.000	4.8	11.04	17.30
3.000	7.2	16.55	---
4.000	9.6	---	---
5.000	12.0	---	---
1.500	3.6	8.3	12.95
1.811	4.35	10.00	---
2.125	5.1	11.75	18.40
2.355	5.65	13.00	---
2.720	6.52	15.00	---
2.975	7.15	16.40	---

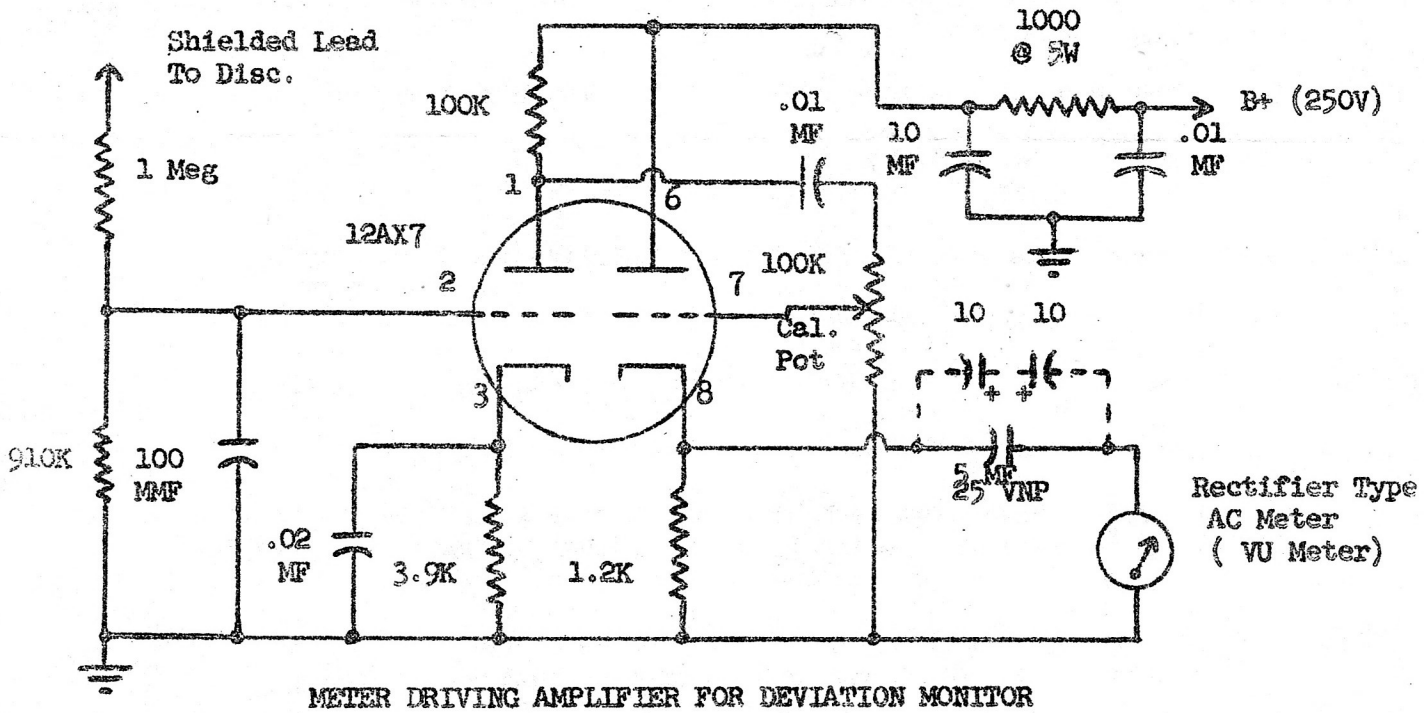
Using the formulas this table can be expanded to almost any extent that your little heart desires.

Some of you are probably thinking at this point that this seems quite complicated and doesn't seem like a very practical way to measure deviation. You'r right. It is somewhat complicated, and you will probably have to read the article thru several times to understand it. However, you only have to go thru this procedure when you wish to calibrate your deviation monitor. At other times you merely read the deviation off the meter. Read on, it's worth it.

The following is a discussion on how to make an FM receiver into a Modulation Monitor and how to use the above information to calibrate it.

In order to achieve deviation monitoring it is necessary to have some sort of an AC (rectifier type) meter that will respond to the maximum modulating frequency (probably around 5 Kc.). This meter should have some sort of a linear scale that can be calibrated in Kc. of deviation. A fixed gain amplifier is required to bring the discriminator output level up high enough to drive the meter. The amplifier must be connected at the discriminator output prior to any deemphasizing networks. This is necessary to insure the flat frequency response of the monitor. The following is a possible circuit for such a monitor.

The circuit is a straight forward triode amplifier followed by a cathode follower driving the meter. The only part which might give you trouble is the 5 Mf. 25 Volt Non polarized electrolytic capacitor. If you cannot find this item a substitute can be made by connecting two 10 Mf. electrolytics back to back. This substitute is shown dotted in on the schematic.



METER DRIVING AMPLIFIER FOR DEVIATION MONITOR

To calibrate this monitor it is only necessary to have a good communications receiver with a narrow bandbass filter, an FM transmitter on the same channel as the monitor/receiver, and an audio generator with accurate frequency calibration.

To outline quickly how to calibrate the monitor, we are going to adjust the transmitter modulating frequency and modulation level so as to get the modulation index to the first zero crossing (First carrier null) of the J_0 Bessel function. This will result in the carrier frequency component being nulled out. This null will be detected on the communications receiver coupled to the FM receiver high I.F.

In detail, couple the communications receiver into the FM receiver high I.F. (Somewhere between 1.7 and 10.7 Mc.). Turn on the FM transmitter and make sure that there is no modulation. Adjust the transmitter (or the receiver) for zero on the receiver discriminator. Tune the communications receiver to the (I.F.) carrier frequency. Then connect the audio generator to the transmitter and set the tone frequency according to the above formulas (or table) in order to get a carrier null to come at the deviation at which you wish to calibrate. Now bring up the modulation level until the carrier signal on the communications receiver nulls out. (This is for the first carrier null. If you are using the second or third null keep increasing the modulation and count the nulls. Stop at the appropiate one.) Note the reading on the AC meter and/or adjust the calibration pot to get the meter

calibrated. The meter can be calibrated at several deviation levels by repeating this process using different tone frequencies.

Several cautions are in order here. (1) Be very careful to make sure that you are on the right null. A little bit of practice with this will get you familiar with the nulling action and the multiple nulls which will be present as shown by the table. (2) Care must also be taken to insure that the bandwidth of the communications receiver is narrow enough (approx. 2Kc) so as not to pass any of the sidebands while observing the carrier null.

One additional tip. If you don't have a narrow bandwidth communications receiver, but do have a sharp pair of ears you can still get the monitor calibrated. Here's how. Rather than watching the S meter for the carrier nulls turn on the communications receiver BFO and adjust the pitch control for about a 400 cycle beat note with the (I.F.) carrier (No modulation on the carrier.). Now bring up the modulation and keep your ears tuned to that 400 cycle note. When it disappears you are on a null. There will be other tones present, and you will have to concentrate on the 400 cycle one to keep from getting confused. A little practice with this will do the trick.

THE CONVERSION below was done by Bill Moore, W9WNB/K9CFP of Ligonier, Indiana and the information was passed along to us by K9KRE.

CONVERSION OF FMT3OD OR BASE EXCITER FROM 42.42 Mc. TO 52.525 MC.

The crystal frequency is 1641.406 Kc. for a multiplication factor of 32.

T 1 . . . . No change, tunes 1641.406 Kc.

T 2 H . . . Remove 20 to 22 turns from each pi-section, tunes 1641.406 Kc.

T 3 H . . . Remove 7 turns from each pi-section, tunes 6565.624 Kc.

T 4 H . . . Remove 2 turns from each winding. Remove from ends of the windings keeping the same spacing between windings, tunes 26,262.496 Kc.

T 5 H . . . Single 807 final. Remove 1 turn from each end of coil, tunes 52.525 Mc.
Double 807 final. Remove 1.5 turns from each end of coil, " "

PA Coil . . Single 807 final. Use 4 turn coil, 1 inch in diameter, tunes 52.525 Mc.
Double 807 final. Use 3 turn coil, 1inch in diameter, " "

CONVERSION OF CHASSIS P-8116-C FROM 42.42 Mc. TO 52.525 MC.

Use the fifth harmonic of the crystal, fundamental crystal frequency is 9965.000 Kc.

T-820 . . . Remove C-4, 7uuf, from the secondary.
Remove C-3, 15uuf, from the primary.
Install the 7uuf removed from the secondary on the primary.

T-821 . . . Remove C-57, 12uuf, from the primary.
Remove C-58, 18uuf, from the secondary.
Install the 12uuf removed from the primary on the secondary.

T-822 . . . Remove C-8, 10uuf.

T-823 . . . Remove C-9, 16uuf, from the primary.
Remove C-10, 7uuf, from the secondary.

Install the 7uuf removed from the secondary on the primary.

(K9KRE says a receiver chassis marked P-8116-CH will tune to 52.525. But it may be neccessary to remove one turn from the coil in T-822)

CORRECTIONS TO "FM NETS" ISSUE 4

Following are corrections to issue 4 of "FM Nets". Included are corrections, additions and deletions received to date. Changes involving the number of stations only are not included. Any additional data on FM nets would be appreciated.

FRQ (MC)	LOCATION	# CALLS	NOTES	
DELETIONS				
52.525	Cedar Rapids, Iowa			
	Mt. Mitchell, N.C.			
145.51	Tampa/St. Pete., Fla.			
146.82	San Diego, Calif.			
147.18	Pittsburgh, Pa.			
CORRECTIONS				
52.525	Greenwood, Ind.	4	W9EIX	
	Battle Creek, Mich.	14	K8UHY	
	Van Wert, Ohio	1	K8EUF	
	Catawissa, Pa.	4	W3MYV	
52.60	Angola, Ind.	1	W9YCB	
	Hicksville, Ohio	1	K8BUH	
146.06	Visalia, Calif.	1	K6KYU	
146.76	San Bernadino, Calif.	?	WA6PCN	
146.94	Kalamazoo, Mich.	6	K8AHX	
ADDITIONS AND NEW DATA				
52.525	Phoenix, Ariz.	6	K7JNK	Can rpt. to 146.85/.94
	Los Angeles, Calif.	3	K6RCX	Second Channel
	Grand Junction, Colo.	1	WØFKY	Just getting on
	Columbus, Ind.	2	W9PEY	
	Galveston, Ind.	1	K9CFG	
	Liberty Center, Ind.	2	W9BRN	
	Plymouth, Ind.	4	W9RWY	
	Ramsey, Ind.	1	K9EDH	
	Rensselaer, Ind.	1	WA9DSL	
	Rochester, Ind.	7	K9FNR	
	Wapatah, Ind.	1	K9DXD	
	Annapolis, Md.	1	K4NZQ/3	
	Baltimore, Md.	1	W3NKY	
	Lambertville, Mich.	1	W8UXU	
	Jackson, Miss.	4	K5VQA	
	Mt. Washington, N.H.	1	W1HQZ	
	Lima, Ohio	?	K8KGF	
	Warren, Ohio	1	K8UES	
52.60	Kokomo, Ind.	2	K9QAU	
52.64	Kokomo, Ind..	1	K9QAU	Used with 146.94
53.29	Chehalis, Wash.	?	?	Info from K7OFO
	Olympia, Wash.	?	?	" " "
	Tacoma, Wash.	?	K7OFO	Total on 53.29 about 200
53.66	Tampa/St. Pete.Bradentn Fla	13	K4YOQ	RACES Zone Net
53.70	Montpelier, Vt.	20	K1PQW	
145.46	Estherville, Iowa	6	WØMDM	Also Calls in Minn.
146.00	Kansas City, Mo.	?	WØJUR	MARTS RTTY

FREQ. (MC)	LOCATION	# CALLS	NOTES	
146.675	San Diego, Calif.	6	WA6OSB	Pt. to Pt. S.D. to L.A.
	Los Angeles, Calif.	20	K6PUW	Narrow Deviation
146.76	Wayne County, Ind.	?	K9LGJ?	Rpt Rcvr to 52.525
146.84	San Diego, Calif.	15	WA6OSB	
146.85	Phoenix, Ariz.	25	K7JNK	Moving to 146.94?
	San Jose, Calif.	9	K6GID	Rptr on 147.71 ???
146.90	Mt. Oso, Calif. (3300 ft)	?	W6HAB	Rptr on Standby basis
	Meadow Lakes, Calif (4700)	?	W6JPU	Rptr Almost Complete
	Mt. Breckenridge, Calif(7700)	?	W6NCG	Rptr. See 145.12
	La Habra Mts. Calif (1500 ft)	?	WA6MPV	Ex Mt. Wilson Station
146.94	Phoenix, Ariz.	?	K7JNK	Just getting started
	Lombard, Ill.	?	WA9FGP	
	Angola, Ind.	5	W9IBF	
	Auburn, Ind.	1	K9ZBM	
	Cambridge City, Ind.	1	K9LGJ	
	Kokomo, Ind.	2	K9QAU	
	Detroit, Mich.	28	W8VWY	Moved from 146.975
	Jefferson City, Mo.	2	WØDSW	
	Smithville, Mo.	1?	WØDDX	
	St. Louis, Mo.	4	WØDSW	
	Charlotte, Tenn.	1	K4CLE	
	Clarksville, Tenn.	2	K4RZA	
	Erin, Tenn.	2	W4ZQP	
	Houston, Texas	1	W5DDJ	
	Charlottesville, Va.	15	K4GPK	
146.975	Charlotte, Tenn.	1	K4CLE	
	Clarksville, Tenn.	2	K4RZA	
	Erin, Tenn.	2	W4ZQP	
147.24	Tampa, Fla.	24	K4YOQ	Moving from 147.25
147.30	Duval County, Fla.	?	W4TKE	
	Nassau County, Fla.	?	?	Info from W4TKE
	St. Johns, Coutny, Fla.	?	?	" " "
	Anna, Ill.	4	W9RNM	
	Charleston, Ill.	2	K9YBO	
	Marshall, Ill.	10	K9IFR	
	Murphysboro, Ill.	3	W9BJE	
	Cambridge, City, Ind.	1	K9LGJ	Receive only
	Connersville, Ind.	1	W9JWH	
	Covington, Ind.	2	K9ACH	
	Lafayette, Ind.	10	W9ASX	
	Richmond, Ind.	?	W9MGW	
	Walkron, Ind.	2	W9NTP	
	Toledo, Ohio	2	W8ESN	
	Pasadena, Texas	8	W5URN	CD
	Winchester, Va.	?	W4TCK	
	LATE DATA			
52.525	Des Moines, Iowa	1	WØQNO	

SOURCES OF USED COMMERCIAL FM EQUIPMENT

Fair Radio Sales
2133 Elida Rd.
Lima, Ohio
(AN/VRC-2 Only)

Selectronics
1206 So. Napa St.
Philadelphia 46, Pa.
(AN/VRC-2 Mainly)

Gregory Electronics Copp.
112 Rt. 46
Saddle Brook, N.J.
(Good supply)

MDC Industries
923 Schiler St.
Philadelphia 40, Pa.
(Limited supply)

J.W. Fantaski, W3RTV
160 Irwin St.
Verona, Pa.
(RCA, list on request)

Communication Service Inc.
3209 Canton
Dallas 26, Texas
(Good supply)

Two-Way Radio Engrs.,
Inc., 1100 Tremont St.
Roxbury 20, Mass.
(Good Supply + Info
via W5FPB)

Northwest Electronics
Inc., PO Box 7
Chesterton, Ind.
(Good supply)

Communications Assoc. Inc.
21-27 Batchelder St.
Boston 19, Mass.
(Motorola strip units)

Mr. Frank Knull
402 Lafayette Ave.
Urbana, Ohio
(30-50D, GE, Link
Info via W9YCB)

Another good source is your local two-way service shop. This is the extent of the sources that we know of at this time. This list will be brought up to date from time to time and any information which you have for this list will be appreciated.

* *

FM READING LIST

The articles, booklets and books listed below are ones which we have found helpful in understanding FM and in adapting used commercial FM gear to ham band operation.

"VHF Repeater Problems and Possibilities", by K6QNY, QST, July 1962, P 26.

"Improving the Link 2365 and 2210", by W4OHM, CQ, Nov 1961, P 40.

"Motorola Mobile Test Set", by W9HKA, 73, March 1961, P 48.

"Two Meter FM For Noise Free Local Communication", by K9QJV, QST, July 1960, P 33.

"Wide-Band FM for the Amateur", Covers conversion of Motorola two meter gear only. Cost $1.75 from James S. Aagaard, K9QJV, Electrical Engineering Dept., Northwestern University, 2145 Sheridan Rd., Evanston, Ill.

"Conversion for Motorola 30D, 50D Receiver and Transmitter (AN/VRC-2)", COvers all Models up to P8116C, Cost 65¢ from: Lloyd G. Hanson, W9YCB, 617 E. Randolph St., Angola, Ind.

"FM Transmitters and Receivers," Dept. of the Army Technical Manual TM 11-668. Cost $1.50. from: U.S. Government Printing Office, Washington 25, D.C.

"FM Nets", a nationwide listing of six and two meter wide-band FM nets. Send Stamped,self addressed, business size envelope with 10¢ postage on it to: Thomas A. McKee, K4ZAD, 1306 Grove Rd., Lynchburg, Va.

"Directory of Wide-Band FM Stations on 52.525 Mc." Cost 25¢ plus postage. From: Jack Cunkelman, W3JKE, Tri-State College Amateur Radio Club, Angola, Ind.

* *

NATIONAL WIDE-BAND FM CALLING AND WORKING FREQUENCIES
52.525 MC 146.94 MC

F M NEWS

VOL. II NR. I
JAN/FEB 1963

-- THE BOX SCORE --
NUMBER OF STATES ON
52.525 MC 146.94 MC
26 18

AGAIN WE GREET YOU, ALL OF YOU WITH THE FUNNY MODULATION. THIS ISSUE WAS SLATED AS OUR REPEATER SPECIAL BUT DUE TO VARIOUS FACTORS WE CHANGED OUR MIND AT THE LAST MINUTE. THIS IS ALSO OUR FIRST ISSUE PRINTED USING RTTY MACHINES WHICH WAS ANOTHER SLOWUP, E CUSES, EXCUSES, EXCUSES.... ACTUALLY FROM NOW ON USING RTTY TAPE SHOULD SPEED THINGS UP MUCH MORE AND IT WILL ALLOW US TO CIRCULATE THE "NEWS" ON RTTY AND STORE IT EASIER. WE PLAN TO HAVE OUR REPEATER SPECIAL OUT VERY SHORTLY.

WE WILL HAVE A DEFINITE LOCATION FOR ALL OUR CORRECTIONS IN THE FUTURE AND THIS WILL BE JUST UNDER THE BOX ON PAGE TWO. SO IF SOME THING WE RECOMMENDED DIDN"T WORK, ALWAYS CHECK ON PAGE TWO IN THE FOLLOWING ISSUE. WELL LETS GET ON WITH THE EDITORIALIZING AND NEWS OF INTEREST TO VHF FM.

STANDARD FREQUENCIES..... NOW IS THE TIME FOR YOU TO WRITE TO THE NATIONAL AMATEUR MAGAZINES AND TO W1BDI, F.E. HANDY , AT THE ARRL AND ASK THEM TO PRINT THE NATIONAL WBFM CALLING FREQUENCIES SOMEWHERE IN THEIR MAGAZINE. YOUR EDITORS ARE MAKING A RENEWED EFFORT TO GET THIS ACCOMPLISHED AND ANY SUPPORT YOU GIVE US WILL HELP GREATLY. YOU MIGHT NOTE THAT IF YOU HAPPEN NOT TO BE ON THE NATIONAL FREQUENCIES OF 52.525 OR 146.94 THAT YOU WISH THEY WOULD PUBLISH THESE SO OTHER NEWCOMERS WOULD NOT HAVE THE SAME PROBLEM.

THE ARRL APPARENTLY DOES NOT BELIEVE THAT THERE IS ENOUGH ACTIVITY ON THE FM FREQS TO WARRANT THIS.....SO PLEASE HELP US CHANGE THEIR MIND.

MORE ON STANDARD FREQUENCIES..... IN PAST ISSUES WE HAVE GIVEN OUR REASONS FOR RECOMMENDING CERTAIN STANDARD FREQUENCIES. BUT UNTIL NOW WE HAVE NOT RECOMMENDED A TWO METER FM RADIOTELETYPE OR RTTY FREQUNCY OR CHANNEL. RECENTLY WE RECEIVED A LETTER FROM BYRON KRETZ-MAN, W2JTP, THE RTTY EDITOR OF "CQ" MAGAZINE' AND HE INCLUDED AN ARTICLE IN WHICH THE USE OF 147.70 MC WAS RECOMMENDED. IN THIS ARTICLE BYRON GIVES THE HISTORY OF TWO METER RTTY AND OUTLINES THE ADVANTAGES FOUND VARIOUS PORTIONS OF THE BAND. WE HOPED TO REPRINT THIS BUT COULD NOT BECAUSE OF ITS LENGTH.

FOR THOSE OF YOU INTERESTED WE SUGGEST READING THE MARCH ISSUE OF "CQ" IN WHICH BYRON WILL SUMMARIZE HIS REASONS FOR SUGGESTING 147.70. WE ALSO RECOMMEND 147.70 FOR TWO METER AFSK RTTY WITH A FEW COMMENTS THROWN IN FOR GOOD MEASURE.

1. AS AM AND FM RTTY ARE INCOMPATIBLE AND SINCE AM IS IN THE LOWER PORTION OF THE BAND WE ARE PROMOTING 147.70 AS AN FM RTTY FREQ. ALTHOUGH AM MAY BE ON THIS FREQUENCY NOW WE EXPECT IT TO EVENTUALLY BECOME ALL FM.

2. ALSO AS 147.70 IS ADJACENT TO BOTH OUR RECOMMENDED POINT TO POINT AND ALTERNATE FREQUENCIES WE SUGGEST THE AUDIO INPUT LEVEL BE HELD DOWN TO WHERE THE TRANSMITTER DEVIATION IS 7.5 KC ON THE RTTY CHANNEL, NOT THE NORMAL 15 KC. THIS WILL MINIMIZE INTERFERENCE TO THE OLDER EQUIPMENT AMATEURS USE.

3. AND AS MENTIONED ABOVE THE RTTY CHANNEL BEING CLOSE TO THE POINT TO POINT CHANNEL MAY IN THE LONG RUN REQUIRE MORE WORK TO ELIMI-NATE INTERFERENCE.

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CORRECTIONS..... FROM K9KRE... IN NOV/DEC 1962 EDITION IT STATES IN THE MOTOROLA CONVERSION INFORMATION THAT A RECEIVER CHASSIS MARKED P-8116-CH WILL TUNE TO 52.525 BUT IT MAY BE NECESSARY TO REMOVE ONE TURN FROM THE COIL IN T-822. AFTER CONVERTING ABOUT TEN OF THESE RECEIVERS HE HAS RUN INTO SOME THAT DO NOT, SO HE NOW SAYS THAT SOME RECEIVERS SO MARKED WILL TUNE WITHOUT CONVERSION EXCEPT POSSIBLY TO T-322, AND EVEN THERE HE WOULD RECOMMEND REDUCING THE CAPACITANCE RATHER THAN "MONKEYING" WITH THE COIL.

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4. ON PAGE 81 OF THE MARCH QST THESE SAME THINGS ARE BRIEFLY MENTIONED, BUT THEY WILL APPRECIATE GETTING COMMENTS SO PLEASE GIVE THEM SOME. ALSO SEND A COPY OF YOUR COMMENTS TO W2JTP.

STILL MORE ON STANDARD FREQUENCIES..... WE KEEP RECEIVING LETTERS ASKING US TO NOT ONLY POINT OUT REASONS FOR MAKING FREQUENCY CHOICES BUT TO FIRMLY RECOMMEND DEFINITE FREQUENCIES FOR VARIOUS USES. BELOW IS JUST SUCH A LIST.....

SIX METERS FM HAS A CHANNEL EVERY 40 KC ABOVE 52.60 MC.

NATIONAL CALLING	52.525 MC
RTTY	52.60
ALTERNATE	52.64
POINT TO POINT	52.72

TWO METERS FM HAS A CHANNEL EVERY 60 KC ABOVE AND BELOW 146.94 MC

NATIONAL CALLING	146.94 MC
ALTERNATE	146.76 OR 147.30
RTTY	147.70
POINT TO POINT	146.64
REPEATER INPUT	146.34

AUDIO TONES ON FM

REMOTE CONTROL	2305 CPS AND 600 CPS
TONE ALERT	1500
RTTY	MARK 2125, SPACE 2975 CPS

K4CLE RUNS 316 KW STATION ON VHF. LEGALLY.... ALRIGHT SO HE IS A WSIX TV ENGINEER.

CRYSTAL HINT..... FOR THOSE OF YOU BUYING CRYSTALS FOR SIX METER RECEIVERS WE PASS ALONG A HINT THAT HAS HELPED MANY A GROUP. THIS IS PRIMARILY FOR THOSE LIVING IN CHANNEL TWO TV AREAS. USE LOW SIDE INJECTION. IT KEEPS THE TV OUT OF YOUR RECEIVER. WHEN FIGURING THE RX CRYSTAL FREQUENCY SUBTRACT THE I.F. FREQUENCY FROM THE OPERATING FREQUENCY, THIS ALSO SAVES YOU THE TROUBLE OF MODIFYING THE OSCILLATOR AND ITS MULTIPLIER COILS.

AND ALSO WHEN YOU BUY THESE CRYSTALS ORDER THE COMMERCIAL GRADE CRYSTALS MADE FOR YOUR UNIT. THIS ASSURES YOU THAT THEY WILL HAVE THE CORRECT LOAD CAPACITANCE AND BE ON FREQUENCY. IT ALSO GIVES YOU A CRYSTAL THAT IS TRADEABLE OR TRANSFERABLE. MANY OF US HAVE TAKEN THE CHEAP ROUTE ONLY TO REGRET IT LATER. WE HOPE THAT YOU WON'T.

SCHEMATICS FOR RCA CMV 3E..... THESE UNITS ARE SIX METER OR LOW BAND AND SCHEMATICS FOR ANYONE NEEDING THEM ARE AVAILABLE FOR 20 CENTS FROM JOHN E. GREVE, W9DGV, 711 44TH STREET, ROCK ISLAND, ILL. QUANTITY DISCOUNTS.

CQ LOS ANGELES..... W7VYC, JERRY W. MANN, 4624 ELEANOR CIR., LAS VEGAS, NEVADA, IS LOOKING FOR SOMEONE IN CALIFORNIA TO WORK WITH IN SETTING UP A SIX METER LINK BETWEEN L.A. AND L.V. AND PLANS A MOUNTAIN TOP REMOTE.

ANOTHER EQUIPMENT SOURCE ..... IS J. W. SEIBERT, W5VLE, 4019 EIGHTH STREET, GULFPORT, MISSISSIPPI... FMTRU30D GEAR.

W3RTV HAS A NEW BATCH OF GEAR ..... AND WOULD ALSO LIKE TO TRADE 50 OR 450 MC RCA UNITS FOR 150 MC RCA, GE OR M GEAR. HE IS IN THE MARKET FOR GOOD FREQUENCY AND DEVIATION MEASURING EQUIPMENT. J. W. FANTASKI, 160 IRWIN ST., VERONA PA.

W4WGE LICKS ALL MOBILE IGNITION NOISE..... BOUGHT A CAR WITH A DEISEL ENGINE.

THE FCC IS RECEIVING PROPOSALS LEFT AND RIGHT THAT CONCERN FM OPERATION FOR ONE REASON OR ANOTHER. IN ORDER THAT YOU WILL BE UP TO DATE WE PASS ALONG WHAT WE ARE AWARE OF.

1. SIMPLIFICATION OF MOBILE LOGGING SEEMS TO BE ONE ON MANY MINDS AND IN JANUARY QST YOU WILL FIND THE DETAILS OF FCC DOCKET NR. 14,853 THAT WILL MAKE THINGS MUCH EASIER. WE UNDERSTAND THAT W5CXJ IN DALLAS, TEXAS HAS PETITIONED THE FCC TO DROP ALL LOGGING OF VHF MOBILES. HE REASONS THAT THE AMATEUR SERVICE IS THE ONLY ONE THAT REQUIRES MOBILE LOGGING IN THE ENTIRE VHF SPECTRUM. THAT'S TRUE AND IS A GOOD POINT.

2. IT IS ALSO OUR UNDERSTANDING THAT WAYNE GREEN, W2NSD, HAS PETITIONED THE FCC TO ALLOW FAST SCAN 1 MC. TELEVISION IN THE UPPER TWO MEGACYCLES OF SIX AND TWO METERS. THE ORIGINAL THINKING BEHIND THIS PROPOSAL NO LONGER HOLDS TRUE, THE OLD POWER LIMIT ON 450 MC. ALSO THEY WOULD HAVE THE PROBLEM THAT ANYTIME A CARRIER WOULD COME ON ANYWHERE IN THE 1 MC BANDWIDTH THEIR TV PICTURE WOULD BE BLOTTO. AND OF COURSE WE WOULD HAVE THE PROBLEM OF OUR SQUELCH OPENING ALL THE TIME. SO WE FEEL THAT FOR EVERYONES BENEFIT TV SHOULD TRY ESTABLISHING ITSELF IN AN UNUSED PORTION OF EITHER THE 220 OR 420 MC BAND. JUST GOT IN THE NEW QST AND THEY ARE BACKING US UP ON THIS. THANK YOU ARRL.

3. SEE JANUARY VHF HORIZONS MAG. EDITORIAL, FOR THEIR MOBILE RELAY PROPOSAL. WE WILL COMMENT ON THIS IN OUR NEXT ISSUE.

A BETTER VHF FM STATION ANTENNA: ONE OF THE MAIN REASONS WHY THE AM BOYS SOMETIMES OUTSHINE US WHEN IT COMES TO WORKING LONG DISTANCES IS CONNECTED WITH THEIR USE OF BEAM ANTENNAS. MIXED FEELINGS SEEM TO EXIST ABOUT THE USE OF BEAMS ON OUR FM NETS. SOME OF US ARE IN FAVOR, BUT MORE OFTEN THAN NOT WE HEAR OBJECTIONS BECAUSE OF THE LOSS OF OMNI-DIRECTIONAL COVERAGE WHICH GOES WITH THE USE OF BEAMS. WE HAVE THIS FEELING OURSELVES SINCE THE ALL DIRECTIONAL COVERAGE IS HIGHLY DESIRABLE IN EMERGENCY SITUATIONS WHERE HAVING A BEAM POINTED IN THE WRONG DIRECTION MIGHT CAUSE A CALL FROM A WEAK MOBILE STATION TO BE MISSED. HOWEVER, THE FACT REMAINS THAT AN EXTRA 7 TO 10 DB ON EACH END OF SOME OF OUR LONGER PATHS WOULD DO WONDERS TO MAKE THEM FULL QUIETING AND WOULD MAKE SOME OF THOSE NOW IMPOSSIBLE HOPS COMMONPLACE. IT MAY SEEM THAT THE ALL DIRECTIONAL REQUIREMENT AND THE HIGH GAIN ARE NOT COMPATIBLE, BUT WE CAN "HAVE OUR CAKE AND EAT IT TOO".

THE SECRET IS TO PHASE A GROUND PLANE, COAXIAL, OR OMNI-DIRECTIONAL GAIN ANTENNA WITH A MODERATE SIZED BEAM TO PRODUCE A "KEYHOLE" SHAPED PATTERN. ROTATE THE BEAM AND YOU CAN FAVOR ANY DIRECTION AND STILL KEEP YOUR LOCAL COVERAGE. SINCE THE POWER GOING UP THE FEEDLINE IS SPLIT, WITH HALF GOING TO EACH ANTENNA, THE GAIN OF THE BEAM WILL BE DOWN 3 DB (OVER ITS NORMAL GAIN) AS WILL THE OMNI-DIRECTIONAL COVERAGE. A 3 DB LOS WILL BARELY BE NOTICED IN YOUR ALL DIRECTIONAL COVERAGE, BUT YOU SURE WIL NOTICE THAT 7 TO 10 DB WHICH YOU PICK UP FROM THE BEAM.

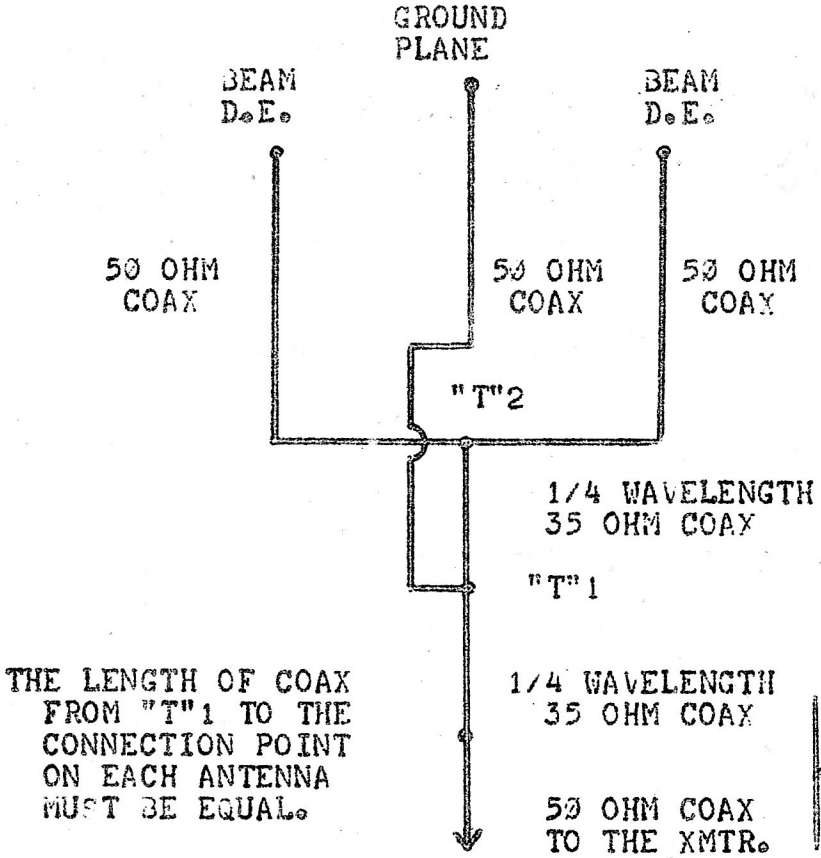
HOW IT'S DONE. TO GET GOOD RESULTS FROM THIS SYSTEM A FEW SIMPLE RULES MUST BE FOLLOWED.

1. THE ANTENNAS MUST BE MOUNTED CONCENTRICALLY ON THE SAME MAST. IT IS OK FOR THE GROUND PLANE TO ROTATE ALSO.
2. THE LENGTH OF THE PHASING SECTIONS FROM THE "T" CONNECTION NEAREST THE TRANSMITTER TO EACH ANTENNA (DRIVEN ELEMENT) MUST BE EQUAL.
3. ALL OF THE COAX IN THE PHASING AND MATCHING SECTIONS MUST HAVE A VELOCITY FACTOR OF 0.66. THIS ELIMINATES THE USE OF THE FOAM DIALECTRIC (LOW LOSS) COAX LINES IN THE PHASING AND MATCHING SECTIONS. THIS TYPE OF COAX IS OK FOR THE MAIN FEED LINE.
4. THE ELEMENTS MUST BE FED SYMMETRICALLY. THAT IS TO SAY THAT ALL DRIVEN ELEMENTS MUST EITHER BE FED ON THE UPPER OR LOWER HALF OF THE ELEMENT, AND THESE FEED POINTS MUST BE ON THE SAME HALF FOR ALL DRIVEN ELEMENTS OF A GIVEN ANTENNA. AS AN EXAMPLE, A GROUND PLANE IS FED ON THE UPPER HALF OF THE ANTENNA . THEREFORE THE BEAMS WHICH ARE USED WITH IT MUST ALSO BE FED ON THE UPPER HALF OF THE DRIVEN ELEMENTS.
5. ALL IMPEDANCES MUST BE MATCHED TO ASSURE AN EQUAL DIVISION OF POWER BETWEEN THE TWO ANTENNAS.
6. THE OMNI-DIRECTIONAL ANTENNA MUST BE MOUNTED A FEW FEET ABOVE (OR BELOW FOR SOME GAIN ANTENNAS) THE BEAM ELEMENTS TO PREVENT INTERRACTION BETWEEN THE ANTENNAS.

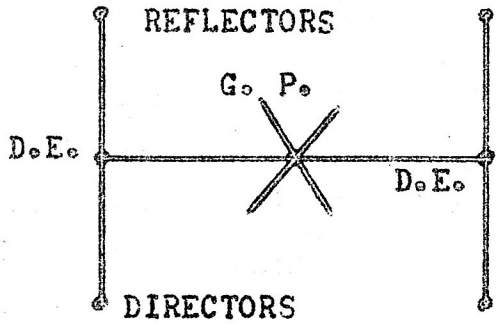
THE DIAGRAMS ON THE NEXT PAGE SHOULD GIVE YOU JUST ABOUT ALL THE ADDITIONAL INFORMATION WHICH YOU NEED TO PUT THIS TYPE OF ANTENNA SYSTEM TOGETHER.

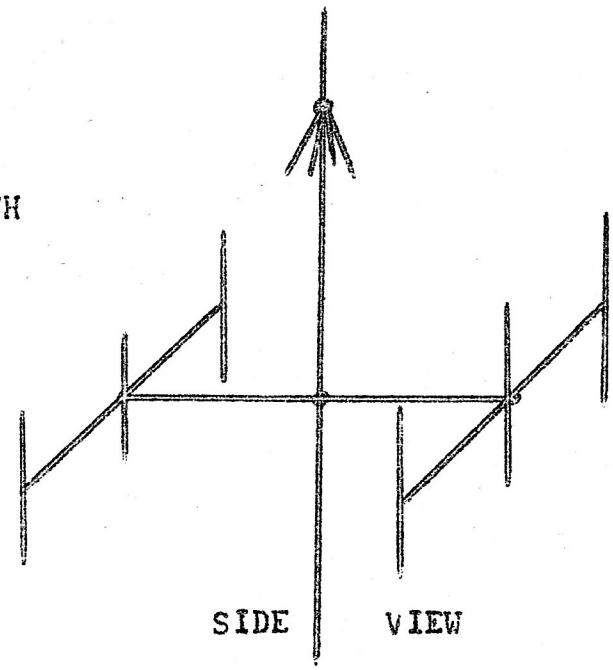
THE IMPEDANCE MATCHING IS QUITE STRAIGHT FORWARD. EACH ANTENNA IS ADJUSTED TO MATCH 50 OHM COAX. THE FEEDLINES FROM THE TWO BEAMS ARE PARALLELED, AND THE FFFECTIVE IMPEDANCE AT THIS POINT IS 25 OHMS. THIS 25 OHM IMPEDANCE IS STEPPED UP TO 50 OHMS AGAIN BY THE USE OF THE 1/4 WAVELENGTH SECTION OF 35 OHM COAX AS A LINEAR MATCHING TRANSFORMER. AT THIS POINT THE 50 OHM COAX FROM THE GROUND PLANE IS CONNECTED, AND THE EFFECTIVE IMPEDANCE IS AGAIN 25 OHMS. BY THE USE OF ANOTHER 1/4 WAVELENGTH SECTION OF 35 OHM COAX THE IMPEDANCE IS AGAIN STEPPED UP TO 50 OHMS. AT THIS POINT THE 50 OHM FEEDLINE TO THE TRANSMITTER CAN BE CONNECTED AND A GOOD MATCH WILL RESULT.

MATCHING AND PHASING LINES


GROUND PLANE
BEAM D.E.
BEAM D.E.
50 OHM COAX
50 OHM COAX
50 OHM COAX
"T"2
1/4 WAVELENGTH 35 OHM COAX
"T"1
THE LENGTH OF COAX FROM "T"1 TO THE CONNECTION POINT ON EACH ANTENNA MUST BE EQUAL.
1/4 WAVELENGTH 35 OHM COAX
50 OHM COAX TO THE XMTR.

FROM THE SKY VIEW





(D.E. MEANS THE DRIVEN ELEMENT)

NOTES:

1. A 1/4 WAVELENGTH SECTION OF COAX LINE WITH A VELOCITY FACTOR OF 00.66 IS 37 INCHES AT 52.72 MC., AND 13.25 INCHES AT 146.94 MC.
2. THE 35 OHM COAX IS RG-83/U. IT IS A SOMEWHAT UNCOMMON ITEM, BUT CAN BE PURCHASED FROM HERBACH AND RADEMAN , INC. 1204 ARCH ST. PHILADELPHIA, 7 PA. IT IS THEIR CATALOG NUMBER TM10K372. MINIMUM ORDER 50 FEET. A 50 FOOT LENGTH WEIGHS 8 LBS. AND COSTS $3.00. A 100 FOOT LENGTH WEIGHS 15 LBS. AND COSTS $5.00.
3. THIS IDEA CAN BE USED WITH 72 OHM ANTENNAS ALSO. JUST SUBSTITUTE 72 OHM COAX WHERE WE HAVE USED THE 50 OHM, AND SUBSTITUTE 50 OHM COAX WHERE WE HAVE USED THE 35 OHM.
4. IF YOU LIKE THE "T" CONNECTION NEAREST TO THE TRANSMITTER CAN BE LOCATED IN THE SHACK. THE LENGTHS OF THE LINES TO THE FEED POINTS ON THE ANTENNAS MUST STILL BE KEPT EQUAL, BUT EITHER LINE CAN THEN BE DISCONNECTED FROM THE "T" AND THAT ANTENNA CAN BE USED SEPARATELY.

NATIONAL WIDE-BAND FM
CALLING AND WORKING
FREQUENCIES
52.525 MC 146.94 MC

- THE -
- F. M. -
- N E W S -

VOL.II NR.II
MAR/APR 1963

--- THE BOX SCORE ---
NUMBER OF STATES ON
52.525 MC 146.94 MC
27 18

BIG ERROR - PLEASE TURN IMMEDIATELY TO ERRATA SECTION ON PAGE 2. --- LONG PAUSE --- NOW WITH RED FACES WE STOP THE EDITORIAL AND BRING FORTH 1.833 CENTS WORTH OF REPEATER INFORMATION. (35 CENTS / 6 ISSUES EQUALS 5.833, MINUS 4 CENT STAMP - EQUALS 1.833 CENTS)

V.H.F. - F.M. REMOTE CONTROL AND REPEATERS

I. INTRODUCTION

A. TERMINOLOGY - REMOTE CONTROL MEANS TO CONTROL A BASE STATION FROM A DISTANCE. TWO USUAL METHODS ARE BY A WIRE LINE AND BY RADIO CONTROL.

"REPEATER" IS A GENERAL TERM FOR WHAT THE FCC CALLS A MOBILE RELAY. THIS IS A STATION DESIGNED TO RECEIVE A VHF FREQUENCY AND SIMULTANEOUSLY RETRANSMIT THE MESSAGE ON ANOTHER FREQUENCY.

YOU SHOULD THINK OF REMOTE CONTROL AND REPEATERS AS SEPARATE FUNCTIONS AT ALL TIMES. WE WILL DESCRIBE THEM SEPARATELY IN GENERAL AND SHOW HOW THEY ARE OFTEN COMBINED FOR AMATEUR USE. SEE ALSO PART "E" FOR DEFINITIONS.

B. REMOTE CONTROL - NOW AN AMATEUR MAY USE REMOTE CONTROL TO BE ABLE TO PLACE HIS BASE STATION ON THE TOP OF A MOUNTAIN WITH ITS OBVIOUS VHF ADVANTAGES. HE MAY DECIDE TO USE THE SIMPLEST METHOD OF REMOTE CONTROL -- WIRE LINE. THIS INVOLVES RENTING A PAIR OF TELEPHONE LINES FROM HIS HOME TO THE MOUNTAIN TOP. IN SOME LOCALITIES THIS IS AN INEXPENSIVE SOLUTION AND SINCE IT IS A MORE POSITIVE METHOD OF CONTROL IS EASIER TO INSTALL AND MEET FCC LICENSE REQUIREMENTS. IF OUR HAM GETS HIS STATION BUILT AND LICENSED, HE HAS THE PLEASURE OF EXTREME RANGE AND ULTRA RELIABLE COMMUNICATION COMPARED TO HIS FELLOW HAMS. NO BIG PROBLEMS ARE PRESENTED AND LOGGING AND IDENTIFICATION ARE CONVENTIONAL.

BUT SAY OUR HAM FRIEND CANNOT GET A PHONE LINE OR THAT A LINE IS TOO EXPENSIVE. SO HE MUST RESORT TO RADIO CONTROL WITH ITS INITIAL EXPENSE OF EXTRA TRANSMITTERS AND RECEIVERS FOR HIS "CONTROL LINK". HE MUST BE CAREFUL BECAUSE THE FCC REQUIRES POSITIVE CONTROL AND THE USE OF FREQUENCIES 220 MC AND ABOVE WHERE OBSTRUCTIONS OFTEN ARE A PATH PROBLEM. HE MUST ALSO CONSIDER THAT THIS RADIO REMOTE CONTROLLED STATION IS A SMALL REPEATER IN ITSELF SINCE HE RETRANSMITS FROM HIS CONTROL OR "UP-LINK" AND RECEIVES VIA A "DOWN-LINK". NOW HE HAS RUN INTO PROBLEMS INVOLVING LOGGING AND IDENTIFICATION. HE MUST LOG AND I.D. NOT ONLY WHEN TRANSMITTING BUT WHENEVER HE IS RECEIVING SINCE A TRANSMITTER IS ON THEN ALSO. THIS CAN BE DONE MANUALLY OR AUTOMATICALLY. A COMPLETE UNDERSTANDING OF FCC REQUIREMENTS AS OUTLINED FURTHER IS RECOMMENDED BEFORE ANY PLANNING IS UNDERTAKEN. VARIOUS FEATURES NOT INCLUDED IN A NORMAL STATION ARE NECESSARY IN A REMOTE CONTROL STATION.

FM NEWS VOL. II NR. 1 MAR/APR 1963

"FM NEWS" IS PUBLISHED BI-MONTHLY BY K4FSU AND K4ZAD. THE PUBLICATION OF THE "NEWS" IS ON A STRICTLY NON-PROFIT BASIS. A 35 CENT SUBSCRIPTION RATE COVERS THE COST OF PAPER AND POSTAGE FOR SIX ISSUES. ADVERTISING IS NOT ACCEPTED BY THIS PUBLICATION. EVERY ATTEMPT IS MADE TO KEEP THE INFORMATION GIVEN AS ACCURATE AND AS COMPLETE AS POSSIBLE. HOWEVER, THE EDITORS ACCEPT NO RESPONSIBILITY FOR ERRORS. ALL MAIL SHOULD BE SENT TO: SEYMOUR PAUL JR.; K4FSU, RT. 2, WATERLICK RD., LYNCHBURG, VA. TELEPHONE 703-239-2520. IF DUE CREDIT IS GIVEN TO OUR AUTHORS ANY PART OF THIS PUBLICATION MAY BE REPRODUCED WITHOUT FURTHER PERMISSION.

ERRATA ------ WHEN WE MAKE A BOOBOO WE DO IT THOROUGHLY. THE TWO METER FM RTTY FREQUENCY IS --- 146.70 --- NOT 147.70. WE HOPE NO ONE BOUGHT CRYSTALS! REMEMBER, 2 METER RTTY ON 146.70 MC. PLEASE SPREAD THE WORD.

CONTINUED FROM PAGE ONE

SO A HAM TO LOCATE A STATION IN A HIGH LOCATION MUST FIRST CONSIDER CONTROLLING IT. HE CAN: 1. LIVE IN A GOOD LOCATION AND CONTROL IT "LOCALLY", 2. USE WIRE LINE REMOTE CONTROL, OR 3. USE RADIO REMOTE CONTROL. ONE OF THESE IS THE FIRST CONSIDERATION IN ESTABLISHING EXTENDED VHF-FM COMMUNICATION IN AN AREA.

C. REPEATING - THE LEGAL AND TECHNICAL ASPECTS OF A REPEATER ARE DISCUSSED LATER BUT THERE ARE OTHER POINTS TO CONSIDER WHENEVER A HAM DECIDES TO "GO REPEAT". WHAT ARE YOUR MOTIVES? THE LOGICAL ONE WOULD BE TO ALLOW OTHERS, PARTICULARLY MOBILES, TO USE THE ADVANTAGES YOU HAVE OR CAN ATTAIN VIA REMOTE CONTROL.

BUT WHAT ARE THE DISADVANTAGES INVOLVED? ONE OF THE MOST IMPORTANT IS YOUR PERSONAL TIME! FOR INSTANCE: HOW DO YOU STAY HOME AND CONTROL THE REPEATER ALL THE TIME? WHAT HAPPENS WHEN YOU WANT TO GO TO A MOVIE ONE EVENING AND AT THE SAME TIME SOMEONE WANTS TO USE "THE REPEATER"? SOMEONE MAY GET DISGRUNTLED. HOW DO THE OTHERS FEEL WHEN YOU GET TIRED OF LOGGING THEM TALKING BACK AND FORTH AND DECIDE TO SHUT DOWN.

WHEN ONE PERSON UNDERTAKES BUILDING AND OPERATING A REPEATER MANY OF THESE AND OTHER PROBLEMS ARISE. WHAT ARE THE BEST WAYS TO SOLVE THEM? WE DO NOT KNOW. IN SOME AREAS THE UNWRITTEN LAW IS TO WORK DIRECT AND THE ONLY TIME THE CHANNEL "B" TRANSMIT OR REPEATER INPUT FREQUENCY IS USED IS IN TIME OF URGENT NEED. ANOTHER WAY TO HELP THE PRESENT SITUATION MIGHT BE TO HAVE A REPEATER LICENSED AND OPERATED BY A CLUB AND RUNNING SHIFTS AND OPERATING DURING CERTAIN TIMES OF THE DAY. (WE DON,T KNOW IF THIS CAN BE LICENSED) MANY HAVE FOUND THAT THE MOST SATISFACTORY SOLUTION IS TO LIMIT THE STATION TO REMOTE CONTROL OPERATION.

AS MENTIONED IN THE LEGAL PORTION OF THIS ARTICLE, THE F.C.C. IS SO UNDEFINED IN THE REPEATER AREA THAT THE ONLY REAL SOLUTION THAT WILL BE EFFECTIVE IS FOR THE F.C.C. TO DETERMINE AND ISSUE A CLEAR SET OF REPEATER REGULATIONS FOR AMATEURS.

WHAT ARE SOME OTHER THINGS TO CONSIDER WHEN CONTEMPLATING REPEATERS? MAINTENANCE CAN BE A BIG PROBLEM IF THE STATION IS LOCATED FAR AWAY. (IMAGINE: 30 MILES ON A ROUGH ROAD, 6000 FEET UP, TWO FEET OF SNOW, ACROSS A CREEK, AND YOU FORGOT YOUR MULTIMETER!) ANOTHER PROBLEM (THERE ARE MORE) IF PEOPLE HAVE ACCESS TO A REPEATER. THIS ENCOURAGES 18 INCH COAT HANGER BASEMENT ANTENNAS AND OTHER LOW PERFORMANCE OPERATION. LIMITING THE USE TO MOBILES HELPS - SOME.

D. FREQUENCIES - FREQUENCY CHOICES FOR REPEATER INPUTS AND OUTPUTS SHOULD BE MADE WITH FUTURE PROBLEMS IN MIND. DISREGARDING THE TECHNICAL PROBLEMS; YOU MUST CONSIDER HOW YOUR REPEATER WILL FIT IN WITH BOTH LOCAL AND NATIONAL OPERATION.

WE HAVEN'T GOT THE ANSWERS BUT WE CAN POINT OUT A FEW OF THE PROBLEMS. THE FIRST IS WHAT ABOUT THE NATIONAL FREQUENCY? IF THE ACTIVITY IN YOUR AREA IS AND WILL BE LIMITED TO A FEW, THE SIMPLEST THING WOULD BE TO REPEAT TO OR FROM THE NATIONAL FREQUENCY. HOWEVER, THIS WILL NORMALLY BECOME A PROBLEM AND HAVE TO BE CHANGED. SO THE BEST WAY MIGHT BE TO REPEAT TO ANOTHER CHANNEL AND MONITOR THE NATIONAL. FOR INSTANCE IN THIS SYSTEM A MOBILE WOULD NEED TWO FREQUENCY TX AND RX. IN CHANNEL "A" HE DOES NOT REPEAT AND WORKS DIRECT (TX AND RX ON 146.94 MC.). IN CHANNEL "B" HE MIGHT TX ON 146.34 MC AND RX ON 146.76 MC.

OTHER THINGS TO REMEMBER: ON SIX METERS REMEMBER THE SKIP SEASON, AND ON TWO METERS AN INPUT ABOVE 147 MC. WILL ELIMINATE TECHNICIANS AND NOVICES. SUGGESTED REPEATER INPUT FREQUENCIES ARE DISCUSSED IN THE TECHNICAL CONSIDERATIONS WITH THE REPEATER DESIGN CURVES. THEY ARE: 2 METERS - 146.34 MC.
6 METERS - 53.00 MC.

E. REPEATER DEFINITIONS - BELOW ARE LISTED VARIOUS TERMS THAT MAY BE HEARD WHEN DISCUSSING REPEATERS. SOME OF THEM ARE USED ONLY LOCALLY AS FAR AS WE KNOW, AND WE ARE NOT ADVOCATING THEIR USE. IT WAS FELT THEY SHOULD BE DEFINED AS WE USED THEM WHILE WRITING THIS ARTICLE.

1. REPEATER OR MOBILE RELAY - SEE PAGE 1, PART I-A.
2. TX - TRANSMIT OR TRANSMITTER.
3. RX - RECEIVE OR RECEIVER.
4. CONTROL LINK - A RADIO FREQUENCY ABOVE 220 MC. USED TO CONTROL A REMOTE STATION.
5. UP LINK - A FREQUENCY, USUALLY THE SAME AS THE CONTROL LINK, USED FROM THE CONTROL POINT TO THE REMOTE STATION TO TALK OR TRANSMIT ON.
6. DOWN LINK - A FREQUENCY USUALLY DIFFERENT THAN 4 OR 5 ABOVE WHICH TRANSMITS A RECEIVED SIGNAL FROM THE REMOTE STATION TO THE CONTROL POINT.
7. DIRECT - TX AND RX ON THE SAME FREQUENCY. NO REPEATER INVOLVED.
8. CHANNEL "A" - AN UNSPECIFIED FREQUENCY, USUALLY THE DIRECT FREQUENCY.
9. CHANNEL "B" - AN UNSPECIFIED FREQUENCY DIFFERENT THAN CHANNEL "A". USUALLY THE REPEATER INPUT FREQUENCY.
10. CARRIER - THE RF COMPONENT OF A TRANSMITTED SIGNAL UPON WHICH AUDIO CAN BE IMPRESSED.
11. C.O.R. - A CARRIER OPERATED RELAY IS A RELAY THAT CLOSES AND OPENS WHEN THE SQUELCH OPENS AND CLOSES.
12. DROP OUT - THE ACTION OF A TRANSMITTER SHUTTING OFF OR A SIGNAL LEVEL DROPPING BELOW READABILITY.

13. DESENSITIZATION - LOSS IN RECEIVER SENSITIVITY CAUSED BY THE PRESENCE OF A HIGH LEVEL RF SIGNAL ON A FREQUENCY NEAR THE RECEIVER CHANNEL FREQUENCY.
14. DIALED UP - TURNING ON A REPEATER WHEN DIGITIAL CONTROL IS USED.
15. DIALED DOWN - THE CONVERSE OF THE ABOVE.
16. TRANSLATOR OR RF REPEATER - A REPEATER IN WHICH THE SIGNAL IS NEVER DEMODULATED, BUT IS ALWAYS HANDLED AS RF. THE PROJECT OSCAR REPEATER IS AN EXAMPLE OF THIS TYPE. WE WILL NOT DISCUSS TRANSLATORS IN THIS ARTICLE.

II. TECHNICAL CONSIDERATIONS - MOBILE RELAY

A. SYSTEM DESIGN - IN THE DESIGN OF A MOBILE RELAY SYSTEM ONE OF THE FIRST QUESTIONS WHICH MUST BE SETTLED IS HOW THE TWO FREQUENCIES INVOLVED WILL BE USED TOGETHER. THE POSSIBLE SYSTEMS ARE:

	MOBILE UNIT		RELAY STATION	
	DIRECT	REPEAT	DIRECT	REPEAT
SYSTEM NR. 1 -	TX-A/RX-A	TX-B/RX-A	TX-A/RX-A	TX-A/RX-B
SYSTEM NR. 2 -	TX-A/RX-A	TX-A/RX-B	TX-A/RX-A	TX-B/RX-A

SINCE THE RELAY STATION IS OF SPECIAL CONSTRUCTION ANYWAY IT IS MORE IMPORTANT TO FIT THE SYSTEM TO THE MANY MOBILES WHICH WILL BE USING IT EVEN IF IT MEANS THAT THE RELAY STATION ITSELF IS A LITTLE MORE DIFFICULT. KEEPING THIS IN MIND, SYSTEM 1 INVOLVES THE USE OF A MOBILE UNIT WITH A TWO FREQUENCY TRANSMITTER AND A SINGLE FREQUENCY RECEIVER. THIS USAGE FITS THE AVAILABLE GEAR MUCH BETTER THAN SYSTEM 2, WHICH WOULD REQUIRE TWO FREQUENCY RECEIVERS FOR THE MOBILE UNITS. SYSTEM 1 ALSO HAS THE ADVANTAGE OF NOT REQUIRING ANY DECISION ON THE PART OF THE MOBILE OPERATOR AS TO WHERE TO LISTEN. THEREFORE NO CALL WILL BE MISSED BECAUSE OF LISTENING ON A DEAD CHANNEL.

THE DISADVANTAGE OF SYSTEM 1 IS THAT A STATION EQUIPPED FOR ONLY DIRECT CHANNEL "A" OPERATION COULD NOT BREAK IN IF THE RELAY WERE ON. SYSTEM 2 WOULD OVERCOME THIS DISADVANTAGE BUT WOULD HAVE DISADVANTAGES ON OTHER POINTS OF COMPARISON. IT IS OUR OPINION THAT SYSTEM 1 INVOLVING TWO FREQUENCY TRANSMITTERS AND SINGLE FREQUENCY RECEIVERS IN THE MOBILE UNITS IS BEST FOR HAM BAND MOBILE RELAY SYSTEMS AND ALL FURTHER DISCUSSION WILL INVOLVE THIS TYPE OF SYSTEM.

B. THE RELAY STATION - IN ITS SIMPLEST FORM (I.E. LOCAL CONTROL) A MOBILE RELAY STATION USES ONLY A SINGLE RECEIVER WITH TWO FREQUENCIES (TO PERMIT DIRECT OPERATION ALSO) AND A SINGLE FREQUENCY TRANSMITTER. HOWEVER, WE DO NOT RECOMMEND THIS SIMPLEST SYSTEM BECAUSE THE RELAY OPERATOR CANNOT MONITOR THE CHANNEL ON WHICH HE IS TRANSMITTING AND BECAUSE OF THIS A MOBILE WITH CHANNEL "A" ONLY, CANNOT BREAK IN EVEN WHEN THE RELAY STATION "DROPS OUT" OR STOPS TRANSMITTING. A BLOCK DIAGRAM OF A STATION USING 2 RECEIVERS TO OVERCOME THIS PROBLEM IS SHOWN AS FIGURE 1.

OPERATION OF THE STATION IS AS FOLLOWS: THE OPERATOR COMPLETES THE CONNECTION AT "X" AND THE SYSTEM IS READY TO RELAY OR "REPEAT". CARRIERS RECEIVED ON CHANNEL "B" CLOSE THE "C.O.R." OR "CODAN" WHICH KEYS THE CHANNEL "A" TRANSMITTER. AUDIO FROM THE CHANNEL "B" RECEIVER DISCRIMINATOR IS FED THRU A SET OF CONTACTS ON THE C.O.R. (WHICH KEEPS NOISE FROM BEING REPEATED DURING THE TIME DELAY), AND THEN THE AUDIO GOES INTO THE CATHODE FOLLOWER TO THE CHANNEL "A" TRANSMITTER AUDIO (MIKE) INPUT. REMOVAL OF CARRIER FROM THE CHANNEL "B" RECEIVER CAUSES THE C.O.R. TO DROP OUT WHICH UNKEYS THE TRANSMITTER. SIMPLE SO FAR!

A DELAY RELAY IS ADDED IN THE KEYING CIRCUIT TO HOLD THE TRANSMITTER ON THE AIR FOR A FEW SECONDS AFTER THE C.O.R. OPENS THIS WILL KEEP THE TRANSMITTER ON EVEN THOUGH THE SIGNAL RECEIVED ON CHANNEL "B" MAY NOT BE CONSISTENTLY STRONG ENOUGH TO KEEP THE C.O.R. CLOSED ALL THE TIME. IT ALSO KEEPS THE TRANSMITTER FROM EXCESSIVE ON-OFF KEYING WHEN MOBILE UNITS ARE TALKING BACK AND FORTH RAPIDLY. THE CHANNEL "A" TRANSMITTER MUTES THE CHANNEL "A" RECEIVER AS IN A NORMAL STATION.

A COMPLETE INTERCONNECTION DIAGRAM FOR THE TRANSMITTER, TWO RECEIVERS, C.O.R., CATHODE FOLLOWER AND DELAY RELAY IS SHOWN AS FIGURE 2. THE CIRCUIT FOR THE C.O.R. IS SHOWN AS FIGURE 3. THE CATHODE FOLLOWER IS FIGURE 4.

C. FREQUENCY SEPARATION - THE FREQUENCY SEPARATION WHICH MUST BE USED BETWEEN THE "A" CHANNEL AND THE "B" CHANNEL TO PREVENT LOSS OF THE WEAK INCOMING CHANNEL "B" SIGNALS IS DEPENDANT ON SEVERAL FACTORS. THESE ARE: 1. THE CHANNEL "B" RECEIVER. 2. THE CHANNEL "A" TRANSMITTER, 3. THE ANTENNA SYSTEM. THESE FACTORS DETERMINE THE MINIMUM FREQUENCY SPACING WHICH CAN BE USED.

THE LIMITATION OF THE MOBILE TRANSMITTERS IS WHAT DETERMINES THE MAXIMUM FREQUENCY SPACING TO BE USED IN THE SYSTEM. THESE MAXIMUM SEPARATIONS WILL VARY WITH FREQUENCY AND EQUIPMENT, BUT SPACING OF 300 KC AT 6 METERS AND 720 KC AT 2 METERS SHOULD BE POSSIBLE WITH ONLY A SLIGHT LOSS IN POWER OUTPUT/INCREASE IN FINAL STAGE DISSIPATION. OPERATION AT GREATER SPACINGS SHOULD BE POSSIBLE WITH MANY TYPES OF GEAR.

TO UNDERSTAND WHY THE REPEATER EQUIPMENT AND ANTENNA SYSTEM ARE SO IMPORTANT ONE MUST BE AWARE OF THE TREMENDOUS DIFFERENCE IN LEVEL BETWEEN THE WEAK SIGNAL WHICH MUST BE RECEIVED ON CHANNEL "B" AND THE STRONG CARRIER WHICH MUST BE RADIATED ON CHANNEL "A". FOR A SYSTEM WITH A .5 MICROVOLT CHANNEL "B" DESIRED SIGNAL AND A CHANNEL "A" POWER OUTPUT OF 50 WATTS THIS DIFFERENCE IS ON THE ORDER OF 160 DB. THEREFORE THE RECEIVER SELECTIVITY AND THE ATTENUATION DUE TO ANTENNA SPACING MUST GIVE A TOTAL OF 160 DB PROTECTION FROM THE CHANNEL "A" TRANSMITTER CARRIER AT THE CHANNEL "B" RECEIVER FREQUENCY.

IN ADDITION THE TRANSMITTER PUTS OUT A NOISE SPECTRUM WHICH MUST BY ATTENUATED BY THE ANTENNA SPACING. FOR THESE REASONS IT CAN BE SEEN THAT CAREFUL SELECTION OF THE EQUIPMENT AND A GOOD ANTENNA INSTALLATION CAN PAY BIG DIVIDENDS IN THE DESIGN OF A MOBILE RELAY STATION.

D. THE RELAY STATION RECEIVER - THE FOLLOWING HINTS SHOULD BE HELPFUL IN PICKING A RECEIVER WHICH WILL GIVE GOOD PERFORMANCE AS A CHANNEL "B" RECEIVER.

1. PICK A RECEIVER WITH THE MAXIMUM NUMBER OF TUNED CIRCUITS BETWEEN THE ANTENNA AND THE SECOND MIXER.

2. CHOOSE A RECEIVER WITH THE MINIMUM NUMBER OF TUBES BETWEEN THE ANTENNA AND THE LOW I.F. INPUT. THE MINIMUM NUMBER IS PROBABLY 3, (R.F. AMPLIFIER, FIRST MIXER AND SECOND MIXER).

3. PICK A RECEIVER WITH ONE R.F. AMPLIFIER, FIRST MIXER, ONE HIGH I.F. AMPLIFIER AND SECOND MIXER OVER ONE WITH TWO R.F. AMPLIFIERS, FIRST MIXER AND SECOND MIXER.

4. PLAN ON SHIELDING (LIKE TRANSMITTER TVI SHIELDING) THE BOTTOM OF THE RECEIVER AND PLACE THE RECEIVER PHYSICALLY AS FAR FROM THE TRANSMITTER AS IS POSSIBLE.

5. DON,T USE A RECEIVER FOR A REPEATER JUST BECAUSE IT IS YOUR .2 MICROVOLT PRIDE. A RECEIVER WITH JUST A LITTLE POORER SENSITIVITY MAY GIVE MUCH BETTER PROTECTION FROM THE ASSOCIATED TRANSMITTER.

6. DON,T PLAN ON ADDING A NUVISTOR (OR OTHER) PREAMP AHEAD OF THE CHANNEL "B" RECEIVER TO "SOUP IT UP".
7. MORE THAN TWO FREQUENCY CONVERSIONS ARE UNDESIRABLE IN A SIX OR TWO METER RECEIVER.
8. DON,T PAY TOO MUCH ATTENTION TO THE ADVERTISED SELECTIVITY IN PICKING A RECEIVER. MANUFACTURERS USUALLY QUOTE 20 DB QUIETING SELECTIVITY WHICH IS OF LITTLE VALUE.
9. DO CALCULATE THE COMMON SPURIOUS RESPONSES FOR THE RECEIVER TO BE USED. SEE APPENDIX "A" FOR AN EXAMPLE OF THIS TYPE OF CALCULATION. THE SPURIOUS FREQUENCIES SHOULD BE CHECKED OUT AGAINST THE REPEATER TRANSMITTER FREQUENCY AND AGAINST OTHER CLOSE BY AND/OR HIGH POWER TRANSMITTERS. EVEN THOUGH THE SPURIOUS RESPONSES MAY BE MORE THE 100 DB DOWN THEY MAY CAUSE TROUBLE IN REPEATER SERVICE. CHANGING THE CRYSTAL(S) TO PUT THE INJECTION VOLTAGE TO THE MIXER(S) ON THE OTHER SIDE (FREQUENCY WISE) CAN OFTEN CURE THIS PROBLEM.
10. LATER MODEL RECEIVERS ARE GENERALLY BETTER.

E. THE RELAY STATION TRANSMITTER - THE FOLLOWING HINTS MAY HELP IN CHOOSING A TRANSMITTER SUITABLE FOR USE IN A REPEATER.
1. PICK A TRANSMITTER WITH A LOW TOTAL MULTIPLICATION (HIGH FREQUENCY CRYSTAL) OVER ONE WITH THE CONVERSE.
2. PICK A TRANSMITTER WITH THE MAXIMUM NUMBER OF TUNED CIRCUITS.
3. A LOW ORDER OF MULTIPLICATION IN THE STAGE FOLLOWING THE OSCILLATOR IS TO BE PREFERRED.
3. USE OF A TRANSMITTER WITH MODULATION LIMITING IS PREFERABLE.
4. LATER MODEL TRANSMITTERS ARE GENERALLY BETTER.

F. METHODS OF ATTENUATION - HERE ARE SOME IDEAS WHICH SHOULD HELP WHEN SETTING UP A SYSTEM TO PROVIDE MAXIMUM PROTECTION FROM PROBLEMS NORMALLY ENCOUNTERED.
1. IT SHOULD BE POSSIBLE TO REPEAT ON ON TWO METERS USING ANTENNA SEPARATION ONLY.
2. SIX METER REPEATERS WILL PROBABLY REQUIRE CAVITIES IN ADDITION TO ANTENNA SEPARATION UNLESS A LOT OF SEPARATION IS AVAILABLE.
3. VERTICAL AND HORIZONTAL SEPARATION CANNOT BE COMBINED TO PICK UP DB,S. ONCE THE ANTENNAS GET VERY FAR OUT OF A ONE OVER THE OTHER CONFIGURATION THE ATTENUATION BECOMES ESSENTIALLY AS IT IS FOR HORIZONTAL SEPARATION ALONE. SEE THE REPEATER DESIGN CURVES (FIGURES 5 AND 6).
4. OMNIDIRECTIONAL VERTICALLY POLARIZED GAIN ANTENNAS WILL GENERALLY GIVE GREATER ATTENUATION THAN WILL GROUND PLANES WHEN SEPARATED VERTICALLY.
5. TO CHECK TO SEE WHETHER IT IS TRANSMITTER NOISE OR RECEIVER DESENSITIZATION WHICH IS BOTHERING A CHANNEL "B" RECEIVER, PLUG A METER INTO A LIMITER WHICH IS UNSATURATED BUT WHICH GIVES SOME INDICATION ON NOISE ALONE. READ THE METER ON NOISE. KEY THE CHANNEL "A" TRANSMITTER. IF THE METER READING RISES YOU ARE PROBABLY BOTHERED BY TRANSMITTER NOISE. IF THE METER READING DECREASES LOOK FOR RECEIVER DESENSITIZATION.
6. MEASURING YOUR ANTENNA ATTENUATION. IF YOU HAVE ACCESS TO A CALIBRATED SIGNAL GENERATOR YOU CAN FAIRLY EASILY MEASURE THE ATTENUATION BETWEEN THE TWO ANTENNAS IN YOUR ANTENNA SYSTEM. BY COMPARING THE RESULTS OF YOUR MEASUREMENTS WITH THE ANTENNA INFORMATION ON THE REPEATER DESIGN CURVES YOU WILL GET A FAIRLY GOOD IDEA OF HOW WELL YOUR ANTENNA SYSTEM IS WORKING ATTENUATION WISE. THERE ARE TWO STEPS INVOLVED IN DETERMINING THE ANTENNA SYSTEM ATTENUATION. FIRST: CONNECT THE SIGNAL GENERATOR DIRECTLY INTO THE RECEIVER AND ADJUST THE GENERATOR OUTPUT TO GIVE SOME CONVENIENT LIMITER READING. READ THE SIGNAL GENERATOR OUTPUT (USE THE DB SCALE IF THERE IS ONE ON THE GENERATOR)

SECOND: CONNECT THE SIGNAL GENERATOR TO ONE OF THE ANTENNAS AND THE RECEIVER TO THE OTHER ANTENNA. RAISE THE LEVEL OF THE SIGNAL GENERATOR OUTPUT UNTIL THE LIMITER READS THE SAME AS IN THE FIRST STEP. AGAIN READ THE SIGNAL GENERATOR OUTPUT. THE DIFFERENCE BETWEEN THE READINGS OBTAINED IN THE TWO STEPS IS THE ATTENUATION BETWEEN THE TWO ANTENNAS.

G. REPEATER DESIGN CURVES - A SET OF CURVES FOR 6 AND 2 METER REPEATERS ARE SHOWN AS FIGURES 5 AND 6. THESE CURVES SHOW LEVELS OF TX NOISE AND RECEIVER DESENSITIZATION AND THE ANTENNA SEPARATION NECESSARY TO OVERCOME THESE EFFECTS. THE CURVES ARE REPRESENTATIVE OF GOOD EQUIPMENT OF THE 1950 TO 1954 PERIOD. THE FEET SEPARATION SCALE GOES WITH THE ANTENNA CURVES WHILE THE FREQUENCY SEPARATION SCALE GOES WITH THE RECEIVER DESENSITIZATION AND TRANSMITTER NOISE CURVES. THE LEFT HAND OR DB SCALE SHOULD BE CONSIDERED TO GIVE ATTENUATION REQUIRED WHEN USED WITH THE TRANSMITTER AND RECEIVER CURVES, AND THEY SHOULD BE CONSIDERED TO INDICATE ATTENUATION YIELDED WHEN USED WITH THE ANTENNA CURVES. THE EQUIPMENT CURVES ARE FOR THE SENSITIVITY AND AND POWER LEVELS SHOWN. HIGHER POWER TRANSMITTERS AND MORE SENSITIVE RECEIVERS WILL GIVE DB FOR DB WORSE FIGURES. FOR EXAMPLE A 3Ø DB HIGHER TX POWER OUTPUT WOULD HAVE A 1Ø DB HIGHER NOISE OUTPUT, AND WOULD REQUIRE 1Ø DB MORE ATTENUATION TO OVERCOME THIS HIGHER NOISE LEVEL.

YOU WILL NOTICE THAT CLOSE IN (SMALL FREQUENCY SEPARATION) THE PROBLEM IS MOST LIKELY TO BE CAUSED BY TX NOISE WHILE AS THE FREQUENCY SEPARATION IS INCREASED THERE WILL BE A CROSSOVER POINT AFTER WHICH THE RECEIVER DESENSITIZATION WILL BE THE LIMITING FACTOR.

IF THE ATTENUATION TO BE HAD FROM ANTENNA SEPARATION IS NOT SUFFICIENT AND CAVITIES HAVE TO BE USED THEIR PLACEMENT IS IMPORTANT. FOR EXAMPLE ASSUME AT A SPECIFIC FREQUENCY THAT THE TRANSMITTER NOISE IS 1Ø DB. WORSE THAN THE RECEIVER DESENSITIZATION, THEN A CAVITY IN THE TRANSMITTER OUTPUT LEAD WILL HELP REDUCE THE NOISE LEVEL. ASSUME THE CAVITY HAS AN ATTENUATION OF 2Ø DB. AT THE RECEIVER FREQUENCY THEN THE TRANSMITTER NOISE WILL BE REDUCED BY 2Ø DB. BUT ONLY THE FIRST 1Ø DB OF THIS WILL HELP TO IMPROVE THE EFFECTIVE RECEIVER SENSITIVITY BECAUSE THE RECEIVER DESENSITIZATION WILL THEN BECOME THE LIMITING ITEM. A CAVITY IN THE RECEIVER INPUT LEAD WILL HELP REDUCE THE DESENSITIZATION PROBLEM.

H. EXAMPLE OF USE OF REPEATER DESIGN CURVES - TO SHOW HOW THE REPEATER DESIGN CURVES ARE USED LET US CONSIDER THE DESIGN OF A TWO METER REPEATER. ASSUME THAT IT IS DESIRED TO USE 146.34 AS THE CHANNEL "B" AND 146.76 AS THE CHANNEL "A". THIS WOULD PUT THE RECEIVER AT THE REPEATER SITE ON 146.34 AND THE TRANSMITTER ON 146.76. THIS IS A SPACING OF 42Ø KC. BY LOOKING AT THE TWO METER REPEATER DESIGN CURVE YOU WILL SEE THAT AT 42Ø KC RECEIVER DESENSITIZATION IS THE LIMITING FACTOR. FROM THE CURVE IT CAN BE SEEN THAT ABOUT 65 DB OF ATTENUATION WILL BE REQUIRED TO INSURE SATISFACTORY PERFORMANCE. THE VERTICAL ANTENNA SEPARATION CURVE INDICATES THAT A LITTLE OVER 5Ø FEET OF VERTICAL ANTENNA SEPARATION WILL GIVE THE REQUIRED ATTENUATION. ABOUT 5ØØ FEET OF HORIZONTAL ANTENNA SEPARATION WOULD MANCE. THE TRICK. THE USE OF VERTICAL SEPARATION AND GAIN ANTENNAS SHOULD MAKE IT POSSIBLE TO GET THE REQUIRED ATTENUATION WITH LESS THAN 5Ø FEET OF SEPARATION. A SYSTEM USING 4Ø FEET OF VERTICAL ANTENNA SEPARATION WITH GAIN ANTENNAS, AND A FREQUENCY SEPARATION OF 42Ø KC WAS SUCCESSFULLY OPERATED IN THE LYNCHBURG (VA) AREA FOR A PERIOD OF SEVERAL YEARS. NO CAVITIES WERE USED, RECEIVER SENSITIVITY WAS .4 MICROVOLTS AND TX POWER WAS 5Ø WATTS.

III. TECHNICAL CONSIDERATIONS - REMOTE CONTROL

A. INTRODUCTION - IN THE NEXT FEW PARAGRAPHS WE WILL BE CONSIDERING MEANS AND METHODS OF CONTROLLING A VHF FM STATION AT SOME REMOTE POINT. AS THE OPERATOR SEES FIT THE STATION MAY OR MAY NOT BE A MOBILE RELAY. AS FAR AS THE REMOTE CONTROL ASPECTS GO IT REALLY DOESNT MAKE MUCH DIFFERENCE. IF THE STATION IS A MOBILE RELAY THEN WE ARE PRIMARILY CONCERNED WITH COMPLETING THE CONNECTION AT "X" IN FIGURE 1. IF THE STATION IS NOT A MOBILE RELAY THERE ARE STILL FUNCTIONS WHICH MUST BE PERFORMED FROM THE CONTROL POINT. IF THE CONTROL SYSTEM IS MADE FLEXIBLE ENOUGH THERE IS ALMOST NO END TO THE THINGS WHICH CAN BE DONE AT THE REMOTE STATION FROM THE CONTROL STATION. MANY HAVE FOUND THE REMOTE CONTROL ASPECT SO CHALLENGING THAT THEY FIND MOBILE RELAY A DULL THING BY COMPARISON. THE IDEA OF DIALING A NUMBER AND HAVING AN ELECTRO-MECHANICAL MONSTER ON A HILL 15 MILES AWAY RESPOND IS QUITE A THING IN ITSELF.

IN THE PARAGRAPHS WHICH FOLLOW WE WILL BE CONSIDERING BOTH THE MEANS USED TO GET THE CONTROL SIGNAL TO THE REMOTE LOCATION (WIRE AND RADIO) AND THE METHODS USED TO CONTROL (TONE, MULTIPLE TONE, DIGITAL TONE, ETC). THE FIGURES SHOW ONLY A FEW OF THE MANY WAYS IN WHICH EQUIPMENT CAN BE INTERCONNECTED TO FORM VARIOUS TYPES OF REMOTE STATIONS, MOBILE RELAY STATIONS, ETC.

B. REMOTE CONTROL BY WIRE LINE - WIRE LINE CONTROL OF A REMOTE VHF FM STATION IS NOT TOO OFTEN USED IN THE HAM SERVICE. IF IT IS USED IT IS USUALLY FOR ONE OR MORE OF THE FOLLOWING REASONS: NO 450 MC FM GEAR AVAILABLE, CANT GET A RELIABLE RADIO PATH FOR THE CONTROL LINK, AND SECURITY (CONTROL BY THE DESIRED STATION ONLY).

LETS TAKE UP THE MATTER OF WIRE EXPENSE FIRST. WIRE EXPENSE SEEMS TO VARY OVER A RATHER WIDE RANGE FROM PLACE TO PLACE. IF YOU ARE CONSIDERING WIRE LINE CONTROL IT IS SUGGESTED THAT YOU PAY A VISIT TO YOUR LOCAL PHONE COMPANY AND FIND OUT WHAT THEY CAN DO FOR YOU AND AT WHAT RATES. YOU WILL PROBABLY FIND THAT THEY HAVE SEVERAL DIFFERENT TYPES OF LINES AVAILABLE AT DIFFERENT RATES. BY CAREFUL PLANNING YOU SHOULD FIND THAT IT IS POSSIBLE TO FIT YOUR SYSTEM TO ONE OF THE CHEAPER RATES. ABOUT THE CHEAPEST RATE THAT WE HAVE HEARD OF FOR A WIRE LINE IS $5.00 PER MONTH WITHIN AN EXCHANGE AREA. THAT IS YOU COULD CONNECT YOUR HOUSE WITH A REMOTE HILLTOP LOCATION FOR THIS FEE PROVIDED THAT BOTH WERE SERVED BY THE SAME TELEPHONE EXCHANGE. ABOUT THE MOST EXPENSIVE THAT WE HAVE HEARD OF, RUN $4.00 FOR THE FIRST QUARTER MILE, AND $1.75 FOR EACH ADDITIONAL QUARTER MILE, PLUS 75 CENTS FOR EACH TERMINATION. ALL MILEAGES ON AN AIRLINE BASIS, AND ALL COSTS ON A PER MONTH BASIS. THESE FIGURES WILL GIVE YOU SOMETHING OF AN IDEA OF WHAT TO EXPECT FOR WIRE LINE EXPENSE.

WIRE LINE OPERATION ALSO IMPOSES SOME VERY DEFINITE LIMITATIONS AS TO THE VOLTAGE, CURRENT, AND AUDIO LEVEL WHICH THE LINES WILL TOLERATE. THESE LIMITATIONS WILL BE SPELLED OUT FOR YOU BY THE PHONE COMPANY WHEN YOU CONTRACT FOR THE LINE. THE LINE IMPEDANCE IS NORMALLY CONSIDERED TO BE 600 OHMS, AND THE LINE SHOULD BE TERMINATED IN THIS IMPEDANCE AT EACH END. IN MAKING MEASUREMENTS ON LINES YOU SHOULD REMOVE THE DEVICE TERMINATING THE LINE AND SUBSTITUTE A 600 OHM RESISTOR. USING A 1000 CYCLE TONE, MEASUREMENTS OF AUDIO LEVEL CAN THEN BE MADE WITH AN AUDIO VOLTMETER (HEATH AV2 OR AV3) ACROSS THE 600 OHM TERMINATING RESISTOR. THE MAXIMUM AUDIO LEVEL WHICH CAN BE FED INTO A LINE WITHOUT CAUSING OBJECTIONABLE CROSSTALK IS NORMALLY CONSIDERED TO BE PLUS 5 DBM AT 1000 CYCLES. IN FEEDING A LINE YOU SHOULD TAKE CARE NOT TO EXCEED THIS LEVEL. AS A ROUNDHOUSE (SAME AS BALLPARK) FIGURE YOU CAN EXPECT 10 TO 15 MILES OF LINE TO HAVE A LOSS OF ABOUT 15 DB.

THEREFORE WHEN YOU FEED AUDIO AT A LEVEL OF PLUS 6 DBM IN, YOU WILL HAVE MINUS 10 DBM AT THE OUTPUT END. MINUS 10 DBM IS STILL AN ADEQUATE LEVEL FOR MOST JOBS. IF YOUR LINE IS ALSO A DC LOOP (PROBABLY USED TO KEY THE REMOTE TRANSMITTER) SOME MEANS WILL HAVE TO BE PROVIDED TO SEPARATE THE AUDIO AND THE DC. THE USE OF TRANSFORMERS IN CONJUNCTION WITH THE BLOCKING CAPACITORS IS STRONGLY RECOMMENDED AS THEY WILL ALSO PERMIT IMPEDANCE MATCHING.

FIGURES 7 AND 8 SHOW GOOD WAYS TO CONNECT A RECEIVER TO A LINE AND A LINE TO A TRANSMITTER. SO MUCH FOR WIRE LINE CONTROL.

C. REMOTE CONTROL BY RADIO - A RADIO LINK IS THE USUAL MEANS WHICH HAMS EMPLOY TO CONTROL A REMOTE STATION. THIS METHOD IS EMPLOYED BECAUSE IT IS USUALLY MUCH CHEAPER FOR THE HAM THAN IS WIRE LINE CONTROL. USED 450 MC GEAR IS AVAILABLE AT ABOUT THE SAME PRICES AS HIGH AND LOW BAND GEAR, SO PROBABLY FOR LESS THAT A YEARS LAND LINE BILLS A HAM CAN GO RADIO CONTROL.

THE 420 TO 450 MC BAND HAS ENJOYED THE MOST USAGE FOR REMOTE CONTROL LINKS BECAUSE OF THE AVAILABILITY OF USED GEAR FOR THIS BAND. 220 MC ALSO ENJOYS SOME USAGE FOR THIS PURPOSE, BUT AS EQUIPMENT HAS TO BE EITHER BUILT OR EXTENSIVELY MODIFIED FOR THIS BAND IT IS NOT AS HEAVILY USED AS THE HIGHER BAND. THE BETTER RECEIVER SENSITIVITIES AND THE HIGHER TRANSMITTER POWER OUTPUTS AVAILABLE IN THE 220 MC BAND MAKE IT THE LOGICAL CHOICE FOR CONTROL LINKS WHERE THE PATH IS QUITE LONG OR NOT LINE OF SIGHT. HOWEVER, THE 420 MC BAND ALSO HAS ITS ADVANTAGES. THIS BAND IS WIDE ENOUGH TO PERMIT DUPLEX OPERATION WITH ONLY ONE ANTENNA. IF YOU DESIRE TO HAVE THE UP LINK AND THE DOWN LINK BOTH IN THE SAME BAND THIS CAN BE A REAL ADVANTAGE TO YOU.

IN ORDER TO DUPLEX ON 420 MC IT WILL BE NECESSARY TO USE A FREQUENCY SEPARATION OF 10 MC OR GREATER. WITH DIFFERENT TYPES OF EQUIPMENT IT MAY ALSO BE NECESSARY TO USE A SMALL CAVITY IN EITHER THE RECEIVER OR THE TRANSMITTER TRANSMISSION LINE. IF CLOSER FREQUENCY SEPARATION IS DESIRED IT SHOULD BE POSSIBLE TO OPERATE WITH A 1 TO 2 MC SEPARATION IF TWO ANTENNAS WITH A VERTICAL SEPARATION OF 10 FEET ARE USED. IN SHORT, DUPLEX ON 420 IS EASY.

THE UP LINK RECEIVER AND THE DOWN LINK TRANSMITTER ARE CONNECTED TO THE OTHER PIECES OF EQUIPMENT USING CATHODE FOLLOWERS, C.O.R.,S ETC. IN MUCH THE SAME MANNER THAT THE MOBILE RELAY EQUIPMENT IS CONNECTED IN FIGURE 2. USUALLY THE DELAY RELAY WHICH KEEPS THE DOWN LINK TRANSMITTER ON THE AIR FOR A FEW SECONDS AFTER THE LAST TRANSMISSION IS HEARD IS ADJUSTED SO THAT THE DELAY IS SOMEWHAT LONGER THAN IT IS FOR THE MOBILE RELAY SYSTEM ITSELF. ALSO IT IS QUITE COMMON TO CONNECT THE UP LINK RECEIVER TO THE DOWN LINK TRANSMITTER. THIS ALLOWS YOU TO MONITOR YOUR OWN UP LINK WHICH CAN BE A VERY HANDY THING. IDENTIFICATION CAN PROBABLY BEST BE DONE BY A CONTINUOUS CODE WHEEL WHICH IS ARRANGED TO TONE MODULATE (AT LOW DEVIATION) THE DOWN LINK TRANSMITTER. AUTOMATIC LOGGING CAN BE DONE AT THE CONTROL STATION BY TAPING OFF THE DOWN LINK RECEIVER OUTPUT. FIGURE 9 SHOWS A BLOCK DIAGRAM OF A REMOTE RADIO CONTROLLED STATION. THE STATION IS SHOWN AS A REMOTE STATION ONLY. HOWEVER, NOTICE THAT BY THE ADDITION OF A SECOND RECEIVER (6 OR 2 METERS) AND ANTENNA (SHOWN DOTTED) IT IS POSSIBLE TO MAKE THE REMOTE RADIO CONTROLLED STATION INTO A REMOTE RADIO CONTROLLED MOBILE RELAY STATION.

D. GENERAL CONTROL METHODS - THERE ARE SEVERAL DIFFERENT METHODS WHICH MAY BE USED TO GET THE REMOTE STATION FROM AN INACTIVE STATUS TO AN ACTIVE STATUS AND BACK AGAIN. MOST OF THESE METHODS ALLOW YOU TO PERFORM ONLY ONE OR TWO ACTIONS AT THE REMOTE STATION. IF YOU ARE ONLY INTERESTED IN ACTIVATING AND DEACTIVATING A MOBILE RELAY THEN PERHAPS ONE OF THESE SIMPLE CONTROL METHODS IS FOR YOU.

MOST OF THE CONTROL SYSTEMS WILL FIT INTO ONE OF THE FOLLOWING CATEGORIES: 1. SINGLE FREQUENCY RF CONTROL. THIS IS A SYSTEM WHERE THE THE PRESENCE OF THE UP-LINK RF CONTROL CARRIER IS REQUIRED IN ORDER FOR THE MOBILE RELAY STATION TO REPEAT. REMOVAL OF THE CONTROL CARRIER DEACTIVATES THE MOBILE RELAY STATION. 2. MULTIPLE FREQUENCY RF CONTROL. WE HAVE NEVER HEARD OF THIS ONE BEING USED. BUT ANYTHING IS POSSIBLE. USING THIS SYSTEM SEVERAL FUNCTIONS COULD BE PERFORMED AT THE REMOTE STATION. THE SELECTION OF FUNCTION WOULD DEPEND UPON WHICH CONTROL FREQUENCY CARRIER WAS BEING RECEIVED. THIS COULD TIE UP A LOT OF EQUIPMENT AS WELL AS FREQUENCY SPACE. FCC MIGHT NOT APPROVE. 3. SINGLE FREQUENCY TONE CONTROL. USING THIS SYSTEM RECEIPT OF A BURST OF A PARTICULAR TONE FREQUENCY ON THE CONTROL LINK WOULD ACTIVATE THE MOBILE RELAY STATION. THE NEXT BURST OF TONE WOULD DEACTIVATE THE STATION. USING THIS SYSTEM THE UP-LINK TRANSMITTER WOULD NOT HAVE TO BE ON THE AIR ALL THE TIME THAT THE MOBILE RELAY STATION WAS IN SERVICE. THIS SYSTEM IS ALSO MORE SECURE IN THAT IT REQUIRES MORE THAN JUST CARRIER TO ACTIVATE THE STATION TO THE REPEAT CONDITION. 4. MULTIPLE TONE SYSTEMS. WITH THESE SYSTEMS EACH FUNCTION REQUIRES ITS OWN TONE FREQUENCY. FOR EXAMPLE REPEAT-ON MIGHT BE 800 CYCLES WITH REPEAT-OFF BEING 1000 CYCLES. ONLY A BURST (3 TO 5 SECONDS) OF TONE WOULD BE REQUIRED SO THE CONTROL LINK TRANSMITTER WOULD NOT HAVE TO BE ON THE AIR ALL THE TIME. ADDING MORE FUNCTIONS REQUIRES THE ADDITION OF MORE TONE TRANSMITTERS AND TONE RECEIVERS. FOR MORE THAN A FEW FUNCTIONS THIS ONE GETS IMPOSSIBLE ALSO. ALTHOUGH ONE OF THESE SIMPLE SYSTEMS MAY DO YOUR JOB AT FIRST, WE WILL BET THAT YOU WILL SOON BECOME DISSATISFIED WITH THE LACK OF FUNCTIONS AVAILABLE AND WILL DESIRE SOMETHING MORE FLEXIBLE.

E. DIGITAL TONE CONTROL SYSTEMS - THE FIFTH OF THE POSSIBLE CONTROL SYSTEMS INVOLVES THE USE OF DIGITAL TONE. IN A DIGITAL TONE SYSTEM A SINGLE TONE FREQUENCY IS PULSED BY A STANDARD TELEPHONE DIAL AT THE CONTROL STATION END. AT THE REMOTE STATION THESE TONE PULSES ARE CONVERTED BACK INTO DC PULSES, AND THE DC PULSES ARE USED TO STEP A STEPPING RELAY. THE STEPPER IS WIRED FOR DIFFERENT FUNCTIONS ON ITS DIFFERENT CONTACTS. USING THIS SYSTEM ONLY ONE RF FREQUENCY AND ONE TONE FREQUENCY ARE REQUIRED FOR A LARGE NUMBER OF FUNCTIONS. IN THIS PART OF THE COUNTRY SEVERAL REMOTE STATIONS HAVE BEEN BUILT USING THIS SYSTEM WITH AS MANY AS 40 DIFFERENT FUNCTIONS AVAILABLE. PERHAPS THIS MAY SEEM LIKE AN UNNECESSARILY LARGE NUMBER OF FUNCTIONS. HOWEVER, CONSIDER A TWO BAND (SIX AND TWO METERS) REMOTE STATION WITH THREE FREQUENCIES AVAILABLE ON EACH BAND, PROVISION FOR OPENING AND CLOSING THE SQUELCH ON ALL RECEIVERS, AND MOBILE RELAY ON ONE OF THE BANDS. THE NUMBER OF FUNCTIONS REQUIRED GOES UP FAST, AND IT IS QUITE EASY TO GET UP TO 30 OR SO.

SINCE THE DIGITAL TONE EQUIPMENT REQUIRED FOR THIS TYPE OF SERVICE IS SO SIMILAR TO THE EQUIPMENT WHICH WE WILL BE DESCRIBING IN OUR TONE ALERT AND TONE CALLING ISSUE (WHICH IS DUE IN A FEW MONTHS) WE ARE NOT GOING TO GO INTO ANY DETAIL ON IT HERE. FOR THOSE WHO LIKE TO EXPERIMENT WE WILL GIVE A FEW DETAILS ON THE SYSTEM, BUT WILL LEAVE THE CIRCUITS FOR LATER.

FIRST OF ALL YOU WILL NEED A TONE GENERATOR AND A TONE RECEIVER. WE ARE SUGGESTING THAT 600 CYCLES OR 2805 CYCLES BE THE STANDARD TONE FREQUENCIES FOR REMOTE CONTROL APPLICATIONS. YOUR TONE EQUIPMENT SHOULD PROBABLY BE BUILT FOR ONE OF THESE. IN BUILDING THIS TYPE OF GEAR YOU CAN TAKE SOME HINTS FROM THE RTTY CIRCUITS. FOR EXAMPLE THE RTTY TONE GENERATORS SHOULD WORK VERY FINE. YOU REALLY ONLY NEED ONE FREQUENCY, BUT YOU MIGHT AS WELL BUILD IN THEM BOTH, MAKING THE SECOND ONE 1500 CPS. FOR TONE CALLING LATER ON. THE DESIRED OUTPUT FREQ. CAN THEN BE SELECTED BY A SWITCH.

THE OUTPUT FROM THE TONE GENERATOR IS USED AS A CALIBRATED BIAS TO GENERATE THE TONE PULSES. TO PREVENT FALSING BY VOICE TONES ETC., IT IS SUGGESTED THAT NEGATIVE KEYING BE USED. BY THIS WE MEAN THAT THE DIAL SHOULD INTERRUPT A CONTINUOUS TONE RATHER THAN HAVING THE DIAL ARRANGED TO PUT OUT A SHORT PULSE OF TONE FOR EACH DIGIT. IT IS ALSO DESIRABLE TO HAVE THE STEPPER RESET AFTER EACH DIALING. FOR THIS REASON FUNCTION RELAYS SHOULD BE USED FOR EACH FUNCTION. THE ONLY JOB OF THE STEPPER WOULD THEN BE TO APPLY OR REMOVE THE VOLTAGE FROM THE FUNCTION RELAYS. EACH FUNCTION RELAY IS STILL LATCHING THRU ONE OF ITS OWN CONTACTS. THE SYSTEM IS SET UP SO THAT THE TONE REMAINS ON FOR 3 OR 4 SECONDS AFTER THE LAST DIGIT IS DIALED. THE REMOVAL OF THE TONE AFTER THIS DELAY THEN RESETS THE STEPPER.

IT IS FURTHER SUGGESTED THAT FOUR DIGITS BE USED TO PERFORM A GIVEN FUNCTION. THE FIRST TWO DIGITS SHOULD BE ACCESS DIGITS WHICH SHOULD DO NOTHING MORE THAN PROTECT THE REMOTE STATION FROM UNAUTHORIZED DIALING ON CHANCE COMBINATIONS OF PULSES. THE LAST TWO DIGITS SHOULD BE THE ONES WHICH ACTUALLY DO THE WORK OF STEPPING THE STEPPER AND SELECTING THE DESIRED FUNCTION RELAY. IN ORDER TO DO THIS TWO STEPPERS WILL PROBABLY BE REQUIRED. ONE SHOULD BE WIRED TO ACCEPT ONLY THE ACCESS DIGITS AND THE SECOND ONE SHOULD BE WIRED WITH A FUNCTION RELAY ON EACH CONTACT.

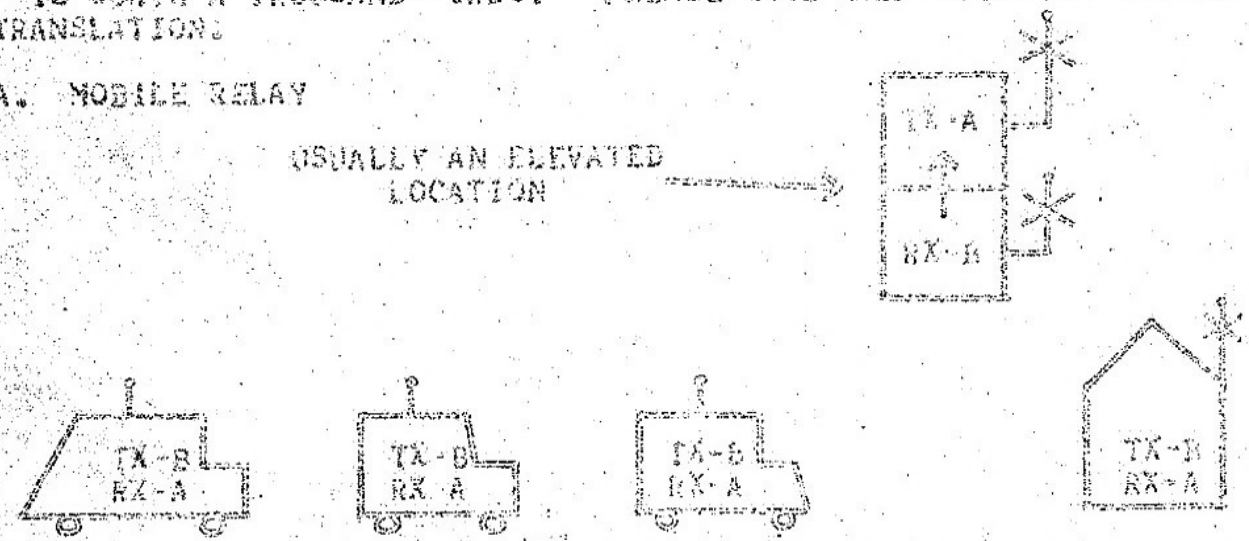
THOSE ARE THE BASICS OF THE SYSTEM. IF YOU LIKE TO EXPERIMENT TRY YOUR HAND AT IT. OUR CIRCUITS WILL FOLLOW IN A FEW ISSUES.

IV. LEGAL CONSIDERATIONS.

"A ROSE BY ANY OTHER NAME, ETC."

THERE APPEARS TO BE A REAL NEED TO STANDARDIZE ON TERMS SUCH AS "REPEATERS, RELAYS, REMOTE CONTROL" AND THE LIKE IN THE AMATEUR RANKS. ALTHOUGH THE FCC AMATEUR RULES (PART 12) DON'T GO INTO THESE AT ANY LENGTH, OTHER PARTS FOR COMMERCIAL USERS DO DEFINE THEM PRETTY WELL SO LETS PIN DOWN A FEW TERMS BY DESCRIBING A COUPLE OF TYPES OF SYSTEMS. CONFUSIONS SAID THAT A PICTURE OF WAYNE WHATEVER HER NAME WAS IS WORTH A THOUSAND WORDS. PLEASE NOTE THE FOLLOWING MODERN DAY TRANSLATION:

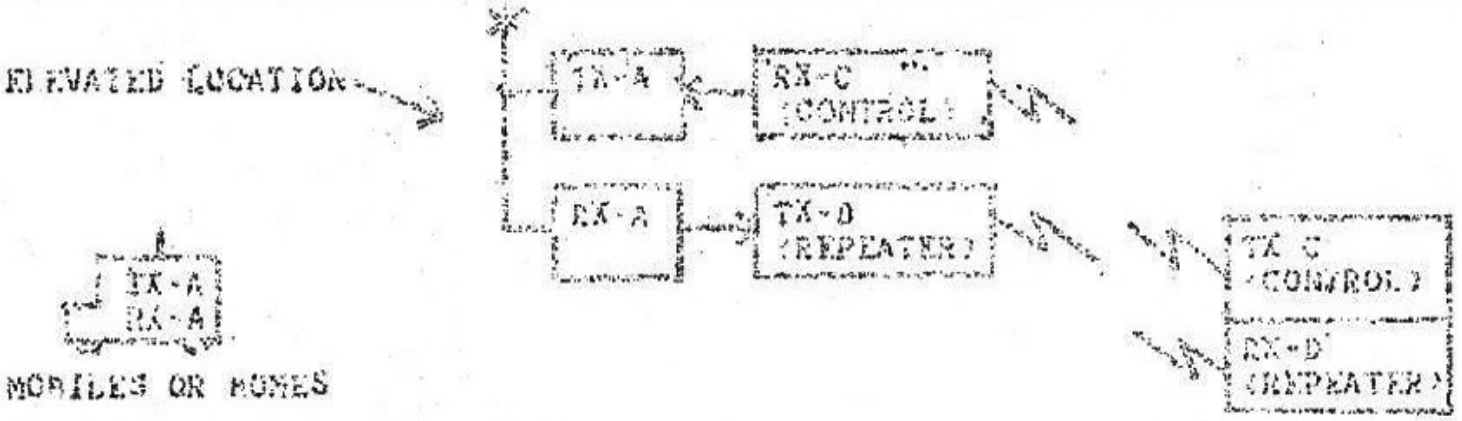
A. MOBILE RELAY



HERE EACH MOBILE AND HOME STATION TRANSMIT ON ONE FREQUENCY (B) AND RECEIVE ON ANOTHER (A). HERE THE MOBILES AND HOMES TRANSMIT THEIR INFORMATION TO THE STATION ON THE HILL AND IT RELAYS TO ALL THE RECEIVERS IN THE SYSTEM SO THAT EVERY UNIT GETS THE ADVANTAGE OF THE HIGH LOCATION. IN FCC PARLANCE THIS IS A "MOBILE RELAY" SYSTEM.

3. CONTROL AND [illegible] TYPE OF [illegible] OPERATION OF REMOTE CONTROL BY RADIO IN WHICH THE CONTROL [illegible] THE BASE TRANSMITTER TO BE ENERGIZED AND TO RETRANSMIT ANY INFORMATION TO THE MOBILE AND HOME STATIONS.

RECEPTION OF A SIGNAL FROM THE MOBILE CAUSES THE REPEATER TRANSMITTER TO ENERGIZE AND RETRANSMIT THE RECEIVED INFORMATION TO THE RECEIVER AT THE CONTROL POINT. NOTE HERE THAT THE REPEATER DIFFERS FROM THE RELAY IN THAT THE REPEATER TRANSMITTER TRANSMITS ONLY TO SPECIFIC POINTS -- NOT TO ALL THE RECEIVERS. NORMALLY THE CONTROL LINK AND THE REPEATER LINK USE DIRECTIONAL ANTENNAS AND ARE HIGHER IN FREQUENCY THAN THE BASE STATION WHICH WOULD COMMONLY USE A NONDIRECTIONAL ANTENNA.



ANY SYSTEM OR STATION MAY BE DESIGNED AROUND EITHER OR BOTH OF THESE BASIC SYSTEMS WHICH MAKES THE TERMINOLOGY A LITTLE MORE HAZY AND TO SOME EXTENT DEPENDS ON THE PARTICULAR WAY THE INFORMATION IS FLOWING AT THE MOMENT. WIRE LINE REMOTE CONTROL CAN ALSO BE USED HERE.

THIS EXAMPLE OF TERMINOLOGY IS NOT INTENDED TO STATE OR IMPLY WHAT IS OR IS NOT PERMISSIBLE UNDER AMATEUR PART 12 RULES. THAT INFORMATION IS IN THE THE FOLLOWING ARTICLE.

V. SOME LEGAL ASPECTS OF AMATEUR "MOBILE RELAY" AND "REPEATER-CONTROL"

BY H.W.MIDDLETON,JR., WA4VE

UNDER TODAYS AMATEUR RULES (PART 12 AS SET OUT IN VOLUME VI TEN 62 THRU REV. TRANSMITTAL VI-62-4) THERE ARE RATHER SEVERE LIMITATIONS AS TO WHAT MAY OR MAY NOT BE DONE IN AMATEUR RELAY OR REPEATER TYPE OPERATION. SECTION 12.64 DESCRIBES IN SOME DETAIL THE "REMOTE CONTROL" OF AN AMATEUR TRANSMITTER INCLUDING THE USE OF RADIO CONTROL. NO SPECIFIC MENTION OF MOBILE RELAY OR REPEATERS IS MADE AT ANY POINT.

PERHAPS THE TWO MOST CRITICAL POINTS IN SECTION 12.64 ARE THE REQUIREMENTS THAT:

1. A DULY LICENSED AMATEUR OPERATOR MUST BE PRESENT AT THE LOCATION OF THE APPARATUS OR AT A SPECIFIC REMOTE CONTROL POINT IN LIEU OF THE REMOTE TRANSMITTER LOCATION.
2. THE "CONTROLLING" TRANSMITTER AT THE REMOTE CONTROL LOCATION MUST OPERATE WITHIN THE AMATEUR BANDS 220 MC OR HIGHER.

THE FIRST OF THESE POINTS MAKE TODAYS AMATEUR "MOBILE RELAY" OPERATION PRETTY MUCH A MATTER OF TWO CONVERSTATIONS OR QSO,S. THAT IS. THE FIRST MOBILE IS IN REALITY TALKING WITH THE STATION DOING THE RELAYING AND THE RELAY STATION IS "PASSING ALONG" THE AUDIO AS HIS TRANSMISSION IN THE SECOND QSO GOING ON BETWEEN HE AND THE SECOND MOBILE. THE FACT THAT THE OPERATOR AT THE RELAY STATION IS RETRANSMITTING THE AUDIO AND NOT NECESSARILY SPEAKING HIMSELF HAS NO BEARING ON THE CONTROL OF THE RELAY STATION WHICH IS UNDER HIS SOLE CONTROL. HE MUST BE PRESENT THERE OR AT ITS AUTHORIZED CONTROL LOCATION.

POINT NUMBER TWO FURTHER RESTRICTS A RADIO CONTROL LINK BETWEEN THE AUTHORIZED CONTROL POINT AND THE REMOTE TRANSMITTER LOCATION. MOST AMATEUR FM OPERATION TAKES-PLACE IN THE SIX AND TWO METER BANDS AND IT IS THEREFORE NECESSARY THAT ADDITIONAL FREQUENCIES (AND TRANSMITTERS AND RECEIVERS) MUST BE TIED UP FOR CONTROL PURPOSES.

PERHAPS THE SIMPLEST AMATEUR MOBILE RELAY STATION IS ONE WHERE THE HAM LIVES OR WORKS ON A HIGH HILL (LIKE SOMEBODY WHO WORKS AT A TV TRANSMITTER AND IS SNOWED IN ALL WINTER). HERE IT IS MERELY NECESSARY THAT HE ARRANGE HIS TRANSMITTER AND RECEIVER ON TWO ANTENNAS (SO THEY CAN RUN AT THE SAME TIME) AND PUT AN AUDIO FEED THRU SWITCH BETWEEN THEM, SO THAT WHILE HE IS TRANSMITTING HE CAN THROW THE SWITCH AND REPEAT WHAT IS BEING SAID ON THE RECEIVER. THIS SYSTEM DOES NOT REQUIRE ANY ADDITIONAL APPROVAL FROM THE FCC OR A SPECIAL LICENSE.

MORE COMPLEX IN MANY WAYS ARE THE STATIONS THAT ARE REMOTELY CONTROLLED BY RADIO. HERE IT IS NECESSARY TO CAREFULLY ANALYZE THE FCC RULES IN ORDER TO COMPLY WITH THEM AND COME AS CLOSE AS POSSIBLE TO THE DESIRED OPERATION WHILE STAYING WITHIN THE LIMITATIONS. IN ADDITION TO THE MOST IMPORTANT SECTION (12.64) COVERING REMOTE CONTROL. ATTENTION SHOULD BE GIVEN TO SECTIONS 12.82 (TRANSMISSIONS OF CALL SIGNS) AND TO 12.136&7 (LOGS). THE FOLLOWING SECTIONS SHOULD ALSO BE CONSIDERED WITH RELAY AND REPEATER OPERATION: 12.7, 12.28, 12.62, 12.66, 12.101, 12.103 (NOTE HERE THE IMPLICATION THAT RETRANSMISSION OF AMATEUR SIGNALS IS ALRIGHT BY THE PROHIBITION OF "OTHER CLASSES" OF STATIONS), 12.104 (FOR TRANSMISSION OF TONE), 12.106C, 12.113, AND LAST BUT NOT LEAST 12.114A. NATURALLY, I,M SURE THAT YOU UNDERSTAND THAT BY MENTIONING THESE SECTIONS THAT I DON,T IN ANY WAY FEEL THAT THE SECTIONS NOT MENTIONED ARE NOT APPLICABLE, THEY ARE OF COURSE AS ON ANY OTHER TYPE OF AMATEUR STATION.

AFTER STUDYING THESE RULES, I,M SURE THERE WILL BE MANY QUESTIONS IN YOUR MIND ON SPECIFIC POINTS. I AGREE THAT IT IS UNFORTUNATE THAT THE FCC RULES ARE SO VAGUE ON THIS TYPE OF OPERATION. HOWEVER, THEY COULD BE VERY TIGHT AND AN EXAMPLE ARE THE RULES COVERING AMATEUR RTTY WHICH HAVE VERY TIGHT SPECIFICATIONS TO BE MET. I AGREE SOMEWHAT TO THE NECESSITY WITH RTTY BECAUSE IT WOULD BE DIFFICULT TO EQUIP EACH MONITORING STATION WITH MACHINES FOR ALL SPEEDS AND ALL KINDS OF SHIFTS.

IN FM VOICE COMMUNICATIONS THE REGULATION SHOULD NOT NEED TO BE SO RESTRICTIVE. IN VIEW OF THE VAGUENESS OF THE CURRENT REGULATIONS IT IS DIFFICULT TO DESCRIBE EXACTLY HOW THE FCC WOULD DECIDE A "GREY-AREA" QUESTION. PERHAPS ONE REASON IS BECAUSE DECISIONS WILL BE MADE BY MORE THAN ONE PERSON IN THE FCC, AND ONE MIGHT SAY YES ON A PARTICULAR QUESTION WHEREAS ANOTHER MIGHT SAY NO TO EXACTLY THE SAME QUESTION. IT IS THE WRITER,S FEELING (AND I JUST MAY BE OUT IN LEFT FIELD) THAT PERHAPS THE BEST COURSE TO FOLLOW IS TO NOT INDIVIDUALLY DISTURB THE FCC ON EITHER DISTRICT OR HIGHER LEVEL WITH YOUR QUESTIONS BUT TO SIT DOWN AND TRY HARD TO INTERPRET THE RULES AS THEY APPLY TO YOUR QUESTION. THEN MAKE NOTES OF WHAT YOUR INTERPRETATION WAS AND MOST IMPORTANT HOW YOU ARRIVED AT IT. IN OTHER WORDS- WHAT WAS THOUGHT ABOUT, WHAT WAS REJECTED AND WHY, WHAT WAS ACCEPTED AND WHY, AND EXACTLY HOW WHAT YOU ARE DOING DOES COMPLY WITH THE RULES. THEN YOU ARE PREPARED FOR A VISIT FROM THE INSPECTOR WITH WRITTEN ANSWERS THAT HE CAN SIT DOWN AND COMPARE WITH THE RULES. I FEEL AND MY LIMITED EXPERIENCE HAS BORNE OUT THAT THIS IS A REASONABLE WAY TO APPROACH THE PROBLEM AND HAS PRODUCED BETTER RESULTS THAN STAMMERING AROUND TRYING TO THINK UP AN ANSWER ON THE SPUR OF THE THE MOMENT.

THERE IS SOME ACTIVITY AFOOT TO SEE IF CHANGES MAY BE MADE IN THE FCC RULES TO MORE CLEARLY DEFINE AMATEUR MOBILE RELAY AND REPEATER OPERATION AND PERHAPS RELEASE OR EASE SOME OF THE CURRENT RESTRICTIONS THAT HAVE BEEN POINTED OUT ABOVE.

FOR THOSE NOT AWARE OF THE ARTICLE REFERENCE IS MADE TO "SCATTER BY ASDKE" JIM KYLE JR. ON PAGE 3 OF THE JAN 63 ISSUE OF "VHF HORIZONS MAGAZINE". THIS IS GOOD READING ON THE MATTERS WE ARE DISCUSSING HERE. JIM'S ARTICLE DOES HOWEVER RAISE SOME QUESTIONS AND COMMENTS IN MY MIND AND I HOPE THAT HE WILL NOT OBJECT TO MY VOICING THEM HERE - HE IS NOT EASILY REACHED ON THE PHONE.

PERHAPS THE FOREMOST QUESTION CONCERNS HIS SUGGESTION THAT THE AMATEUR MOBILE RELAY STATION BE AUTHORIZED FOR A SPECIFIC AMATEUR BAND ONLY. THIS WORDING MAY BE A LITTLE TROUBLESOME FOR TWO REASONS: FIRST, IT IS RESTRICTIVE BECAUSE SOME AMATEUR OPERATION IS DONE ON A CROSS-BAND BASIS NOW (THAT IS FROM SIX TO TWO AND VICE VERSA). SECOND, IT MAY NOT BE RESTRICTIVE ENOUGH BY NOT LIMITING THE MOBILE-RELAY OPERATION TO THE HIGHER FREQUENCIES.

ACTUALLY A MOBILE RELAY DOESN'T SERVE ANYWHERE NEAR AS VALID A PURPOSE ON FREQUENCIES BELOW TEN METERS BECAUSE OF THE PROPAGATION CHARACTERISTICS WHERE HILLTOPS ARE OF NO GREAT ADVANTAGE - SUCH AS THEY ARE ON THE VHF FREQUENCIES WHERE LINE OF SIGHT PROPAGATION IS SO IMPORTANT. CONSIDERING THE PRESENT DAY USAGE OF THE BANDS BELOW TEN METERS (AS WELL AS THE PROPAGATION) I DOUBT THAT THE FCC WOULD LOOK FAVORABLY UPON MOBILE RELAYS UNLESS THEY WERE LIMITED TO THE FREQUENCIES TEN METERS OR HIGHER. PERHAPS BETTER WORDING OF THIS PART WOULD BE ALONG THE LINES "WITHIN AMATEUR BANDS ABOVE 28 (OR 50) MC." THE CHOICE OF 28 OR 50 MC IS BEYOND THE SCOPE OF THIS ARTICLE.

A QUESTION ALSO ARISES CONCERNING "SPECIFIC SHOWING BY THE APPLICANT THAT THE PUBLIC INTEREST WILL BE SERVED BY SUCH AUTHORIZATION WILL BE REQUIRED". NO DOUBT JIM WISHED TO SHOW HOW TIMELY STATIONS WOULD BE OF VALUE IN TIMES OF CIVIL EMERGENCY, SUCH AS FLOODS, FOREST FIRES, AND THE LIKE. CERTAINLY AMATEUR-RADIO WOULD NOT BE PERMITTED AT ALL IF IT WAS NOT RECOGNIZED TO SERVE THE PUBLIC INTEREST, AND IT APPEARS THAT SPECIFIC SHOWING WOULD BE HARD TO DESCRIBE UNTIL THE EVENT OCCURS. THE JUDGEMENT OF WHETHER A SPECIFIC STATEMENT WAS ADEQUATE WHEN CONSIDERED BY DIFFERENT PEOPLE PROCESSING THE APPLICATION MIGHT VARY. LETS NOT HAMPER OURSELVES WITH ADDITIONAL VAGUENESS IN WHAT IS REQUIRED TO SATISFACTORILY COMPLY WITH THE RULES.

LASTLY AND LEASTLY, THE STATEMENT SAYING THAT THE STATION BE DESIGNED AND INSTALLED SO THAT IT MAY BE DEACTIVATED BY REMOTE CONTROL IN CASE OF EMERGENCY COULD PERHAPS BE IMPROVED IN WORDING BY USE OF A DIFFERENT WORD INSTEAD OF EMERGENCY. CERTAINLY WE WISH THE STATION TO BE AVAILABLE IN THE CASES OF CIVIL EMERGENCY SO THAT WE MAY PERFORM IN THE PUBLIC INTEREST. BETTER WORDING PERHAPS COULD INDICATE THE STATION BE DEACTIVATED BY REMOTE CONTROL IN CASE IT IS FOUND VARYING FROM FCC RULES OR MILITARY EMERGENCY.

EVEN THOUGH I HAVE PICKED AT THE ABOVE POINTS, I WANT TO CONGRATULATE JIM AND THANK HIM FOR STARTING THE BALL ROLLING AND WANT TO COMPLIMENT HIM ON THESE POINTS IN HIS ARTICLE:

1. THE TIE-IN TO PUBLIC INTEREST AND SERVICE.
2. A GOOD BALANCE OF TECHNICAL REQUIREMENTS, NOT TO MANY OR TOO FEW.
3. THE MENTION OF COMMERCIAL USE OF SIMILAR TYPES OF STATIONS BY RULE NUMBER.

IN THE DRAFTING OF PROPOSED RULE CHANGES, WE SHOULD TRY HARD TO LOOK THROUGH THE EYES OF THE FCC, SO TO SPEAK. BY THIS I MEAN THAT WE SHOULD CONSIDER AND TRY TO DRAFT SO AS TO NOT INCREASE THE WORK LOAD OF THEIR ALREADY SHORT STAFF, BOTH IN THE HANDLING OF APPLICATIONS AND IN THE MONITORING GROUP. THEY HAVE A FULL-TIME JOB NOW AND WE WILL STAND A MUCH BETTER CHANCE OF GETTING WHAT WE DESIRE IF WE DO NOT GIVE THEM ADDITIONAL WORK TO DO; ESPECIALLY IF IT REQUIRES ADDITIONAL PERSONNEL.

THIS ARTICLE IS ALREADY TOO LONG, HOWEVER BEFORE CLOSING I WILL MENTION THAT I HAVE DISCUSSED AND ASSISTED IN COMPLETING INFORMATION NECESSARY FOR SEVERAL SUCCESSFUL APPLICATIONS FOR REMOTE CONTROL BY RADIO IN WHICH MOBILE RELAY AND REPEATER-CONTROLS WERE INVOLVED. MANY TIMES A SIMPLE BLOCK DIAGRAM SHOWING WHAT IS LOCATED WHERE, AND WHAT TALKS TO WHAT, IS EXTREMELY VALUABLE. OFTEN TRYING TO GO THROUGH A WORD DESCRIPTION BECOMES EITHER VERY DIFFICULT OR ENTIRELY HOPELESS, ESPECIALLY IF THE TERMINOLOGY ISNT WELL PINNED DOWN. INCIDENTALLY, ONE POINT OF INTEREST IS THAT MY EXPERIENCE INDICATES THAT THE FCC DESIRES TO SEE THE SIGNALS TO SUSPEND TRANSMISSION (12.64B5) BE ABLE TO ENTER BY MORE THAN ONE FREQUENCY SO THAT IF THE NORMAL CONTROL RECEIVER IS INOPERATIVE OR BLOCKED BY ANY OUTSIDE CARRIER OR INTERFERENCE, THE SIGNAL COULD GO IN BY ANOTHER RECEIVER AND HAVE THE DESIRED EFFECT. THIS CAN BE DONE BY TWO RECEIVERS ABOVE 220 MC, HOWEVER MY OWN APPLICATION WAS APPROVED WITH THE STATEMENT THAT THE "BASE" (TWO OR SIX METER) RECEIVER WOULD ALSO BE CAPABLE OF RECEIVING THE SIGNALS TO SUSPEND.

I WELCOME YOUR COMMENTS ON THESE MATTERS, AND THOUGH IT MAY TAKE A WHILE, I WILL TRY TO OFFER MY ANSWERS AND ADDITIONAL COMMENTS IN RETURN. MAIL CAN BE SENT EITHER IN CARE OF THE EDITORS OF THE "FM NEWS" OR DIRECT TO ME AT 1223 FENWICK DRIVE, LYNCHBURG, VA. PHONE 703-239-0444.

WARREN MIDDLETON, W4DYE

VI. SUGGESTED READING.

A. "REMOTE CONTROL WITH A 420 MC LINK" BY W2ZGP AND W2TTU, QST, JULY, 1953, PAGE 32.
B. "VHF REPEATER PROBLEMS AND POSSIBLLITIES" BY K6QNY, QST, JULY, 1962, PAGE 26.
C. "SCATTER BY K5JKX", VHF HORIZONS, JANUARY, 1963, PAGE 3.
D. "MORE MOBILE RELAY" BY K5JKX, VHF HORIZONS, APRIL, 1963, PAGE 6.

VII. CONCLUSION.

WE HAVE INCLUDED THE BASIC PROBLEMS AND TECHNIQUES INVOLVED WITH AMATEUR REPEATERS. THE SPECIFIC MANNER IN WHICH THEY ARE USED OR ARE BUILT IS UP TO THE INDIVIDUAL. WE REALIZE THAT FOR SOMEONE EXPERIENCED IN BUILDING REPEATERS OUR ARTICLE IS SKIMPY AND LACKING IN TECHNICAL INFORMATION. BUT WE FEEL THAT A HAM UNFAMILIAR WITH THE SUBJECT CAN GET A GOOD GENERAL PICTURE FROM THIS MATERIAL. WE DIDNT MENTION A NUMBER OF SMALL BUT IMPORTANT AIDS SUCH AS A CODE WHEEL FOR IDENTIFICATION, THE USE OF A TAPE RECORDER FOR LOGGING, CROSS BAND REPEATING AND SO FORTH. THE COMMONLY USED NEGATIVE KEYING TONE CONTROL WILL BE COVERED IN OUR UPCOMING TONE ISSUE.

ANOTHER THING TO REMEMBER IS THAT YOU MUST MONITOR ALL FREQUENCIES AT YOUR CONTROL POINT THAT YOU TRANSMIT REMOTELY. QUESTIONS SENT US THAT ARE OF GENERAL INTEREST WILL BE ANSWERED IN THE "NEWS". WE WILL WELCOME ANY COMMENTS ON HOW TO DO THE JOB IN AN EASIER OR BETTER WAY THAN WE SUGGEST. ALSO IF A LIST OF PERSONS OPERATING HAM REPEATERS COULD BE ASSEMBLED WE WILL BE GLAD TO PUBLISH IT.

IT TOOK US TWO MONTHS TO WRITE, PUT ON RTTY TAPE, MAKE STENCILS, REPRODUCE, COLATE, ETC THIS ISSUE (300 COPIES) SO WE FEEL WE HAVE AN EXCUSE FOR A LATE ISSUE. FOR THOSE OF YOU READING THE "NEWS" FOR THE FIRST TIME MAKE NOTE THAT A NORMAL ISSUE IS 5 TO 7 PAGES LONG-NOT 24. IN OUR NEXT ISSUE WE WILL HAVE SOME NEWS TO REPORT FROM THE WORLD OF HAM FM, SOME OF OUR READERS COMMENTS, AND A SHORT TECHNICAL SECTION.

FOR THOSE OF YOU WHO HAVE REQUESTED BACK ISSUES WE ARE KEEPING A RECORD AND WHEN WE REPRINT YOU WILL GET THEM (NOT SOON).

ANY ERRORS THAT WE OR YOU FIND WILL BE CORRECTED IN THE ERRATA SECTION OF FOLLOWING ISSUES.

LOCALLY CONTROLLED MOBILE RELAY - BLOCK DIAGRAM

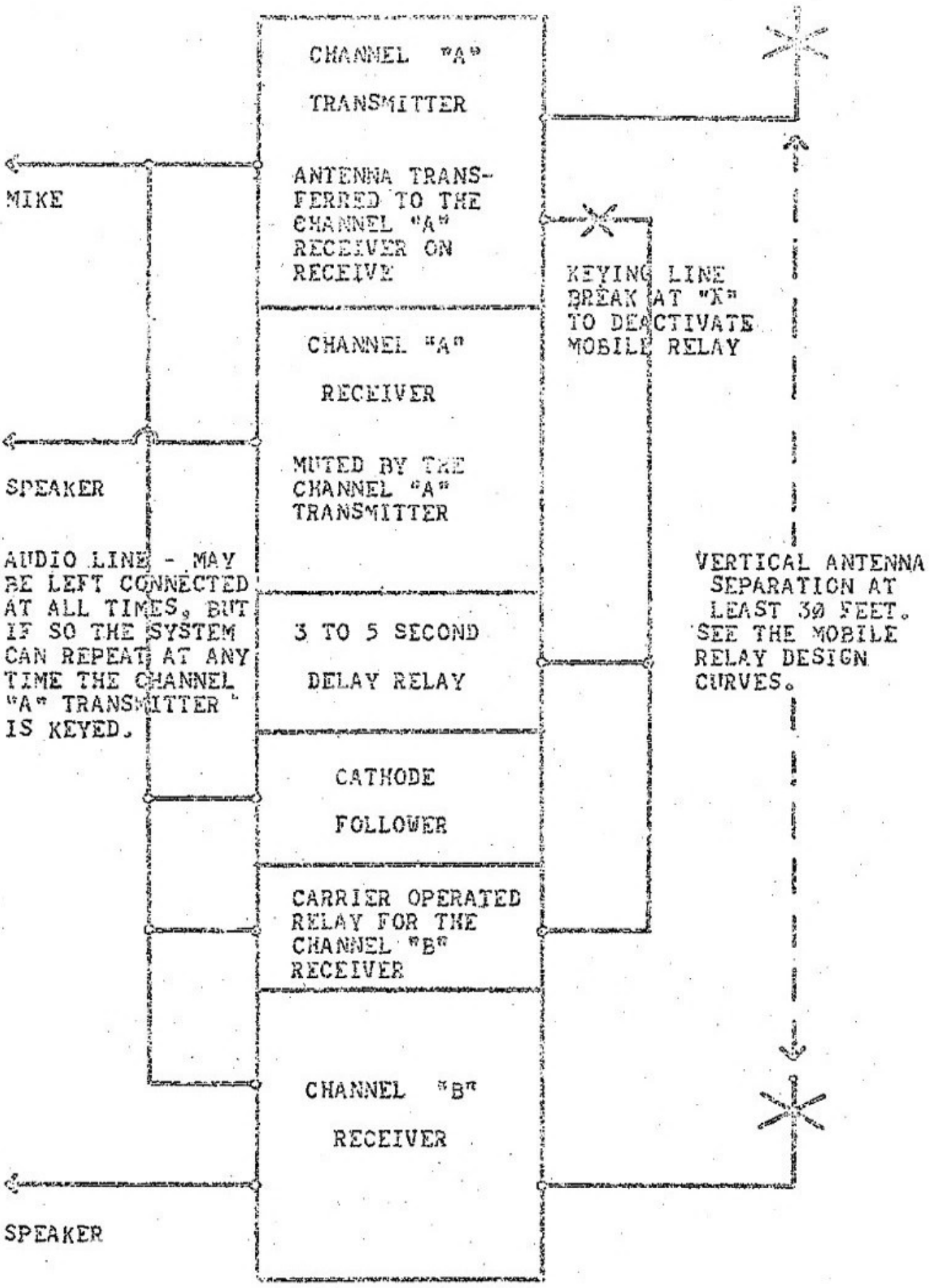
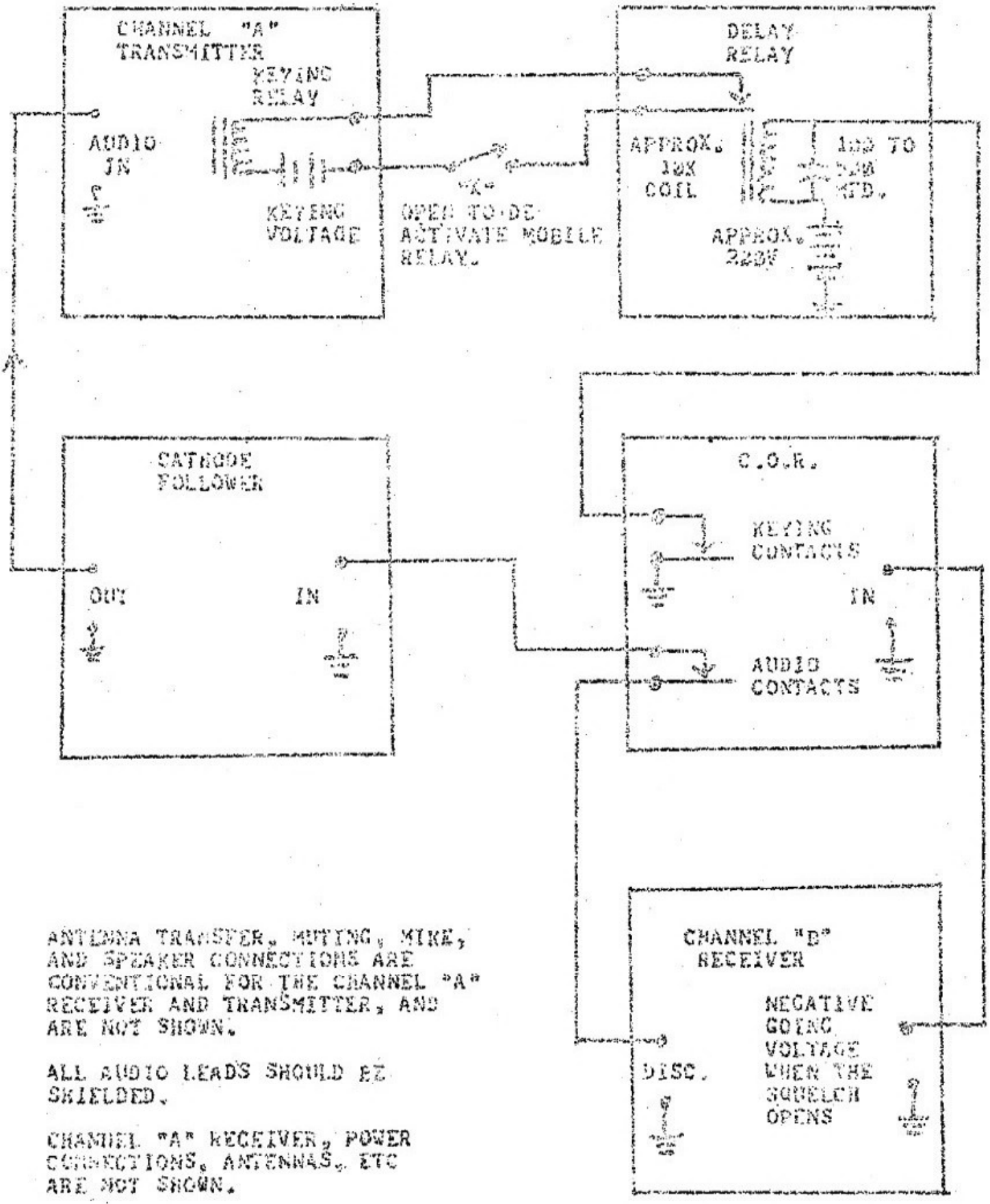

CHANNEL "A"
TRANSMITTER
ANTENNA TRANSFERRED TO THE CHANNEL "A" RECEIVER ON RECEIVE
MIKE
KEYING LINE BREAK AT "X" TO DEACTIVATE MOBILE RELAY
CHANNEL "A"
RECEIVER
MUTED BY THE CHANNEL "A" TRANSMITTER
SPEAKER
AUDIO LINE - MAY BE LEFT CONNECTED AT ALL TIMES, BUT IF SO THE SYSTEM CAN REPEAT AT ANY TIME THE CHANNEL "A" TRANSMITTER IS KEYED.
3 TO 5 SECOND
DELAY RELAY
VERTICAL ANTENNA SEPARATION AT LEAST 30 FEET. SEE THE MOBILE RELAY DESIGN CURVES.
CATHODE
FOLLOWER
CARRIER OPERATED RELAY FOR THE CHANNEL "B" RECEIVER
CHANNEL "B"
RECEIVER
SPEAKER

FIGURE 1

LOCALLY CONTROLLED MOBILE RELAY STATION — INTERCONNECTION DIAGRAM

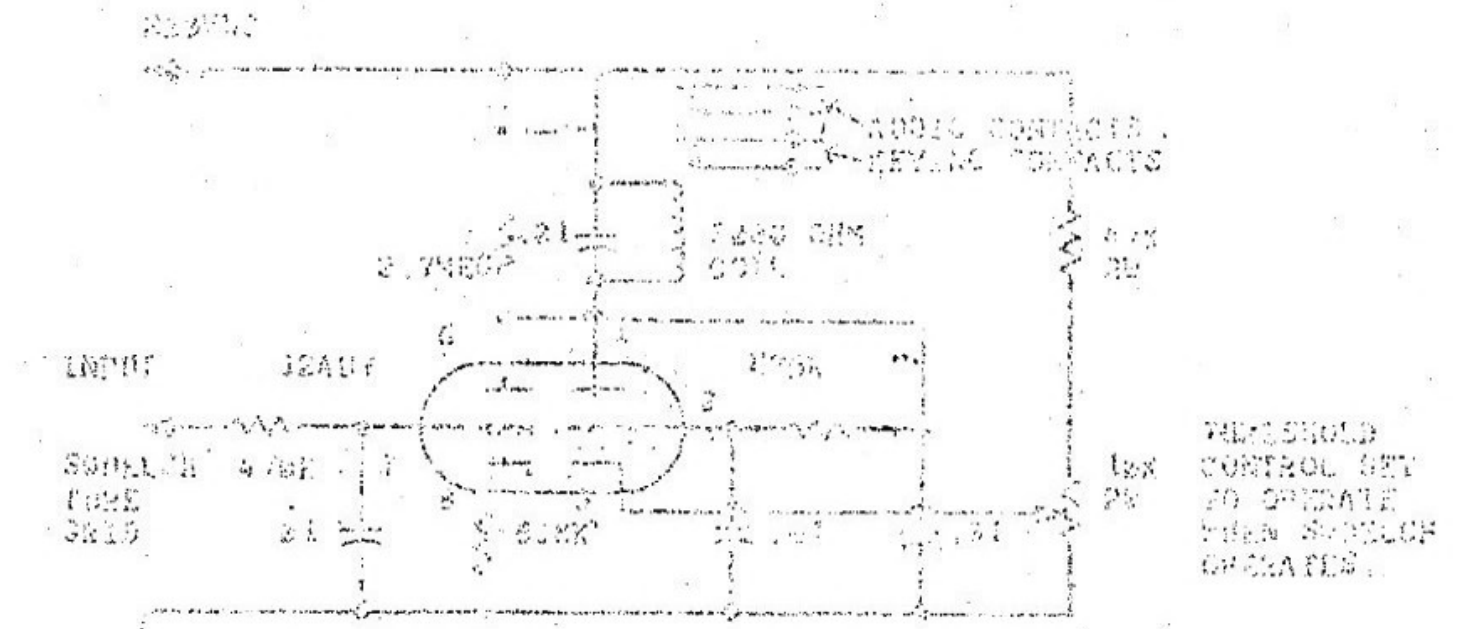


ANTENNA TRANSFER, MUTING, MIKE, AND SPEAKER CONNECTIONS ARE CONVENTIONAL FOR THE CHANNEL "A" RECEIVER AND TRANSMITTER, AND ARE NOT SHOWN.

ALL AUDIO LEADS SHOULD BE SHIELDED.

CHANNEL "A" RECEIVER, POWER CONNECTIONS, ANTENNAS, ETC ARE NOT SHOWN.

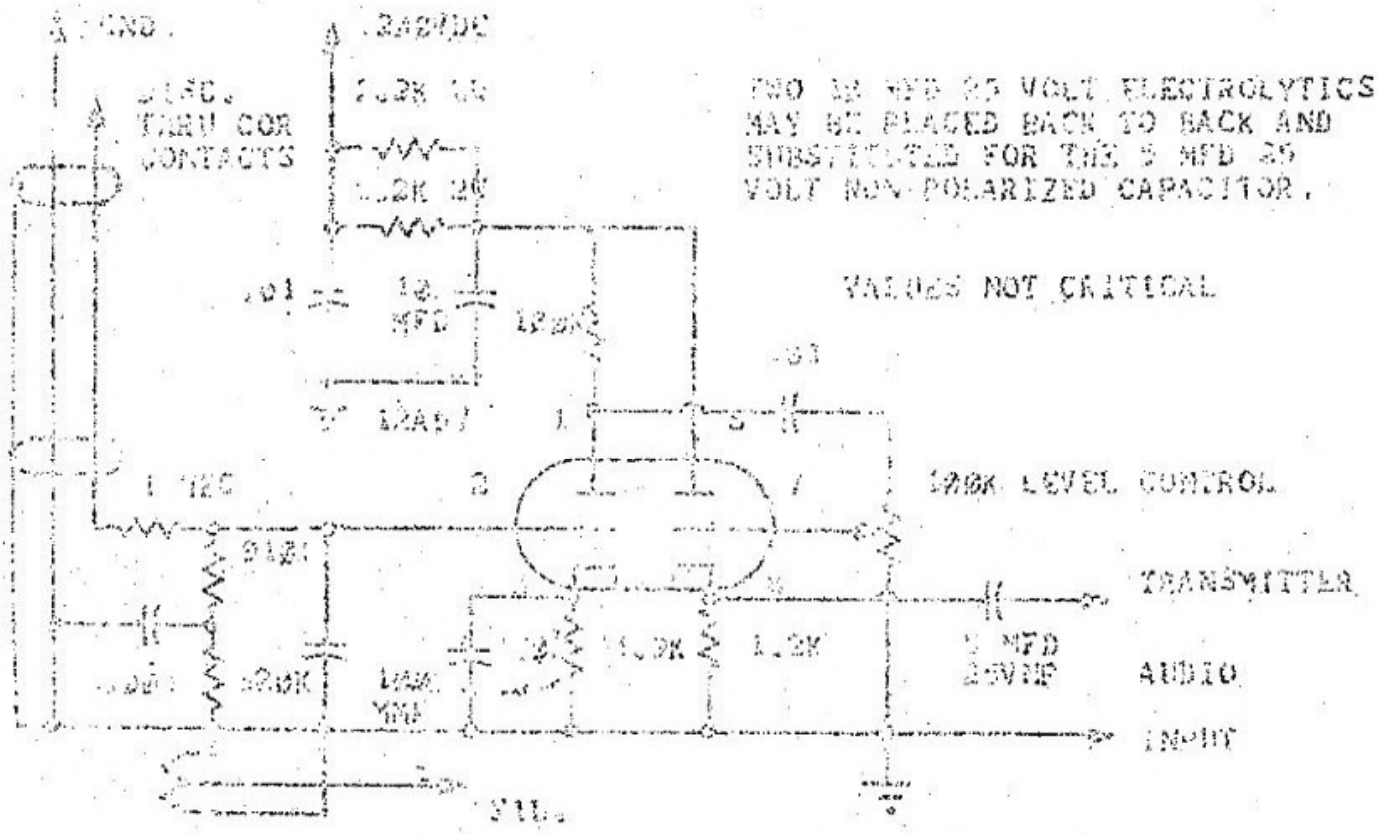
FIGURE 2 (USE WITH FIGURE 1)

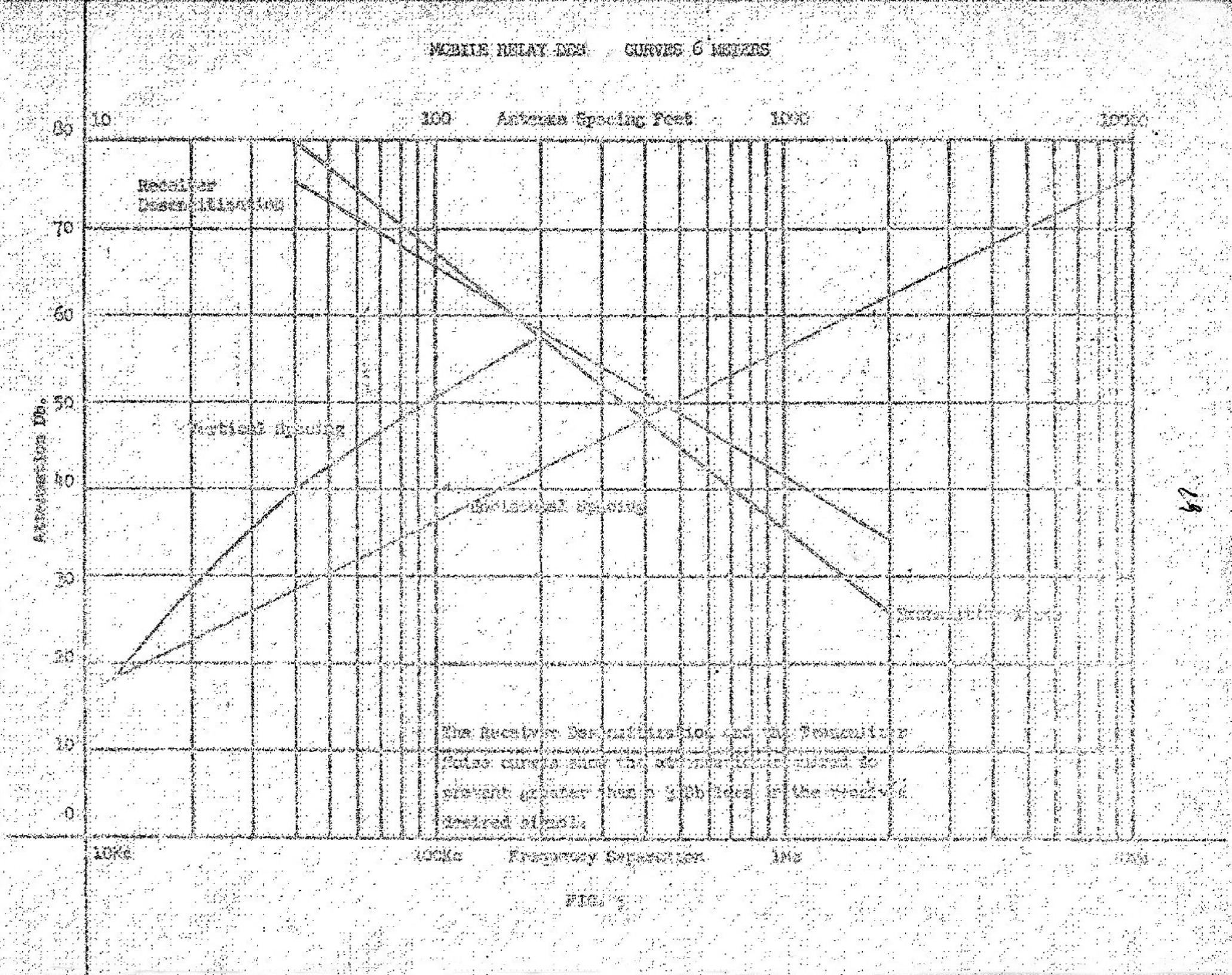


THE INPUT CONNECTION SHOULD GO TO A GRID WHICH PROVIDES A NEGATIVE GOING VOLTAGE AS THE SQUELCH OPENS.

CATHODE FOLLOWER CIRCUIT

FIGURE 7


TWO 10 MFD 25 VOLT ELECTROLYTICS MAY BE PLACED BACK TO BACK AND SUBSTITUTED FOR THE 5 MFD 25 VOLT NON-POLARIZED CAPACITOR.
VALUES NOT CRITICAL
1 MEG LEVEL CONTROL
TRANSMITTER AUDIO INPUT



The Receiver Desensitization for the Transmitter Pulse curve is the attenuation required to prevent greater than 3 Db desensitization of the receiver's desired signal.

FIG. 9

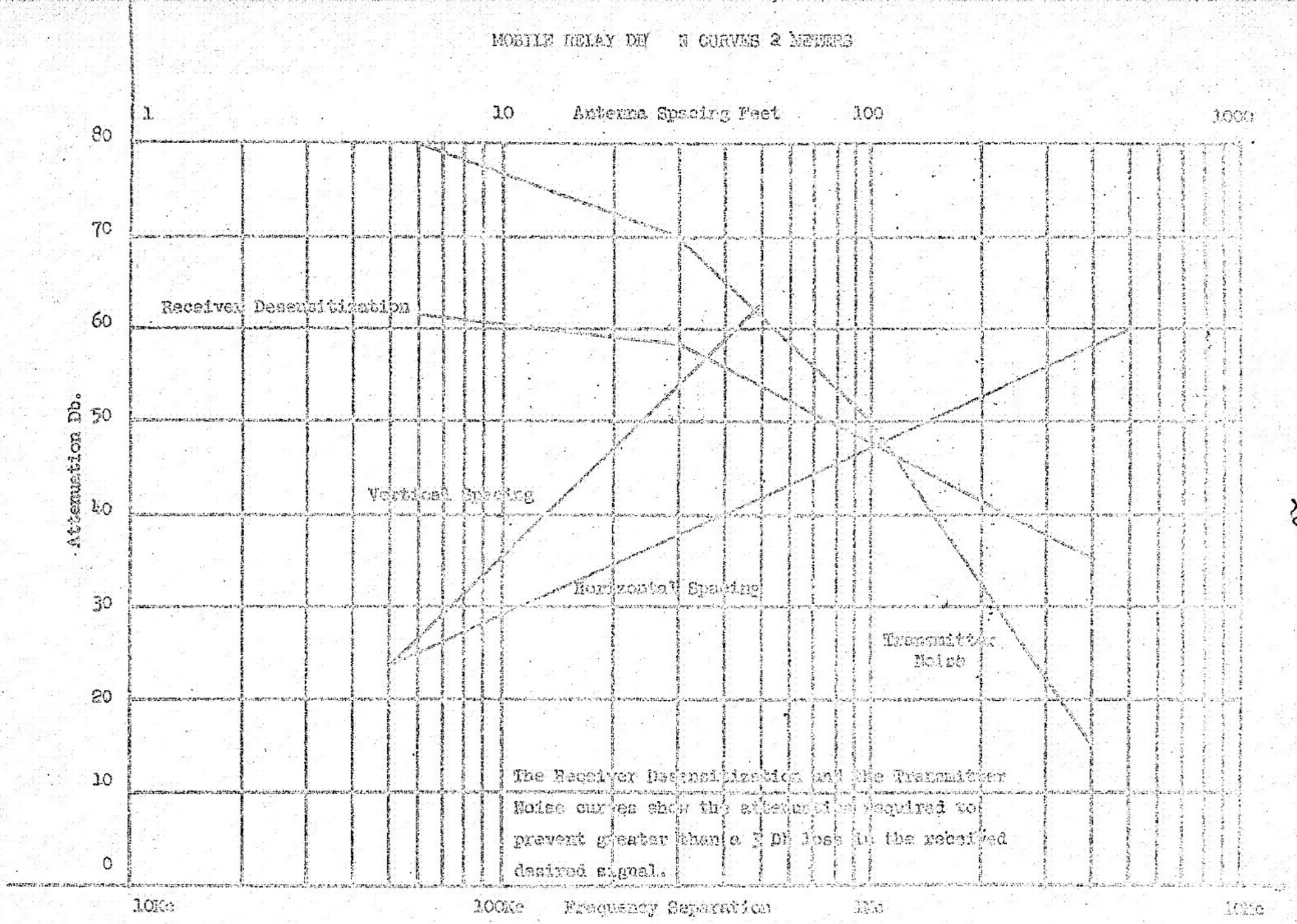
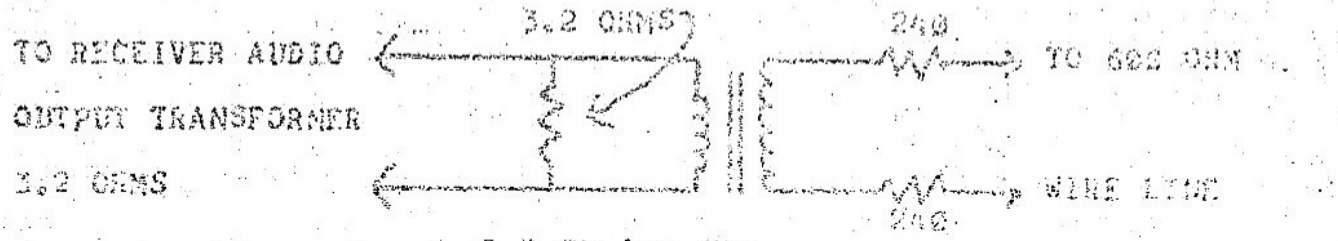

MOBILE RELAY DAY N CURVES 2 METERS
1
10
Antenna Spacing Feet
100
1000
80
70
60
50
40
30
20
10
0
Attenuation Db.
Receiver Desensitization
Vertical Spacing
Horizontal Spacing
Transmitter Noise
The Receiver Desensitization and the Transmitter Noise curves show the attenuation required to prevent greater than a 3 Db loss in the received desired signal.
10Kc
100Kc
Frequency Separation
1Mc
10Mc

FIG. 6

CONNECTING A RECEIVER TO A WIRE LINE

FIGURE 7



3.2 TO 600 OHM
TRANSFORMER

THE VOLUME CONTROL SHOULD BE ADJUSTED SO THAT THE MAXIMUM AUDIO LEVEL APPLIED TO THE LINE (WHEN RECEIVING 1000 CYCLE TONE TRANSMITTED AT 10 KC DEVIATION) IS PLUS 5 DBM.

OTHER SYSTEMS OF FEEDING A RECEIVER TO A LINE ARE POSSIBLE. HOWEVER, IT IS IMPORTANT TO USE SOME MISMATCH IN CONNECTING THE TWO TOGETHER. IF NO MISMATCH IS USED THE SETTING OF THE RECEIVER VOLUME CONTROL FOR THE MAXIMUM LINE LEVEL WILL BE VERY LOW. THIS WILL MAKE THE HUM LEVEL HIGH IN RELATION TO THE DESIRED AUDIO. ON THE OTHER HAND, IF TOO MUCH MISMATCH IS USED THEN THE VOLUME CONTROL WILL HAVE TO BE RUN WIDE OPEN TO GET SUFFICIENT LEVEL TO FEED THE LINE. THIS WILL RESULT IN THE RECEIVER AUDIO STAGES RUNNING AT MAXIMUM DISTORTION. A GOOD RULE OF THUMB HERE IS TO HAVE THE VOLUME CONTROL SET AT SOMEWHERE NEAR MID-RANGE WITH THE MATCHING SYSTEM SET UP TO GIVE THE DESIRED LINE LEVEL.

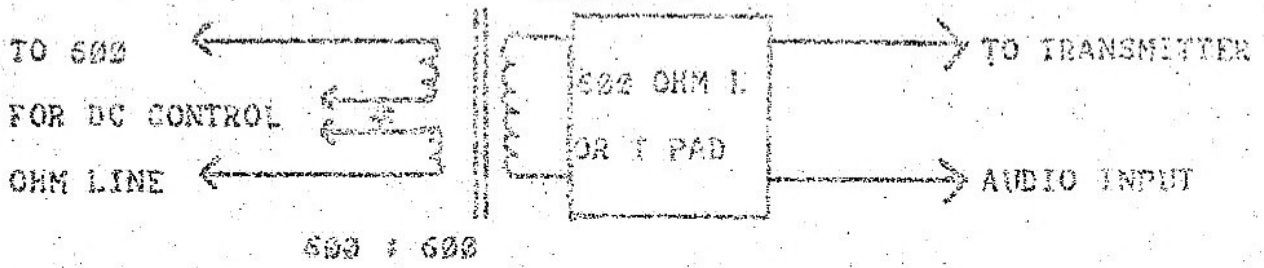
ANOTHER GOOD CIRCUIT WOULD INVOLVE THE USE OF A 3.2 TO 600 OHM TRANSFORMER AND A 600 OHM PAD (BALANCED TYPE) FEEDING THE LINE.

REMEMBER THAT IT IS IMPORTANT THAT THE LINE BE KEPT BALANCED WITH RESPECT TO GROUND.

XXX XXX XXX XXX XXX XXX XXX XXX XXX XXX XXX XXX XXX

MATCHING A LINE TO A TRANSMITTER

FIGURE 8

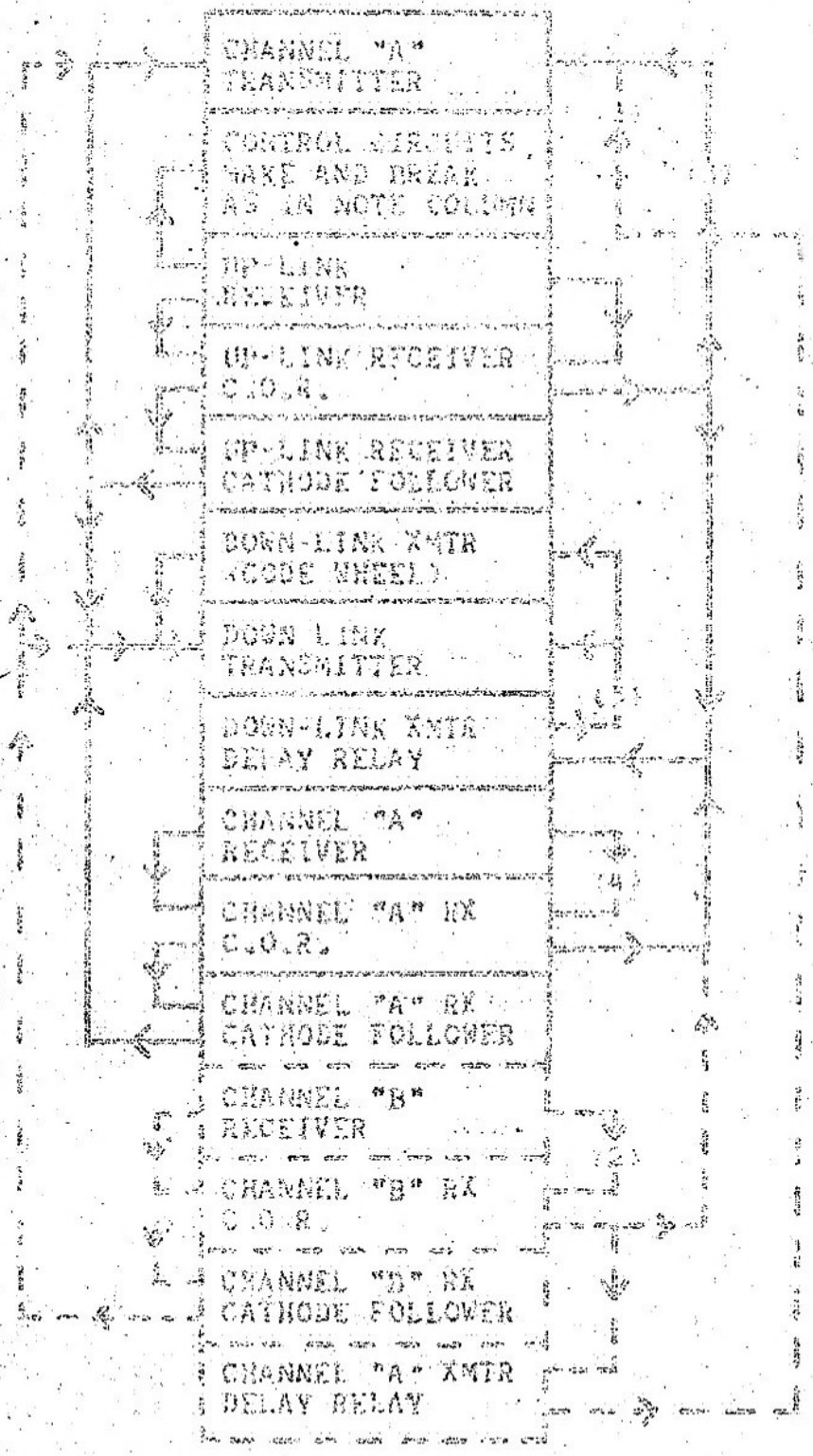


600 : 600

IN SETTING UP THE MODULATION ON A TRANSMITTER FED FROM A LINE FOLLOW THESE STEPS: (1) APPLY A SIGNAL (1000 CYCLES AT 1 VOLT) TO THE TRANSMITTER AUDIO INPUT. THIS LEVEL SHOULD CAUSE THE AUDIO LIMITERS IN THE TRANSMITTER TO SOLIDLY LIMIT. (2) SET THE MODULATION POT FOR MAXIMUM (15 KC) DEVIATION AND NEVER AGAIN TOUCH THE MODULATION POT. (3) APPLY TO THE L OR T PAD THE AUDIO (1000 CYCLE) WHICH EXISTS AT THE TRANSMITTER END OF THE LINE AS A RESULT OF FEEDING IN PLUS 5 DBM AT THE OTHER END OF THE LINE. (4) ADJUST THE L OR T PAD SO THAT THE DEVIATION OF THE TRANSMITTER IS 10 KC. WITH THE MODULATION SET UP IN THIS MANNER THE DEVIATION WILL AVERAGE AROUND 10 KC WITH THE PEAKS ON VOICE GOING TO 15 KC.

RADIO CONTROLLER OF THE FUTURE — BLOCK DIAGRAM

FIGURE 4



NOTES

BREAK AT (3) TO DEACTIVATE MOBILE RELAY OPERATION

BREAK AT (2) TO DEACTIVATE CHANNEL "B" RECEIVER

BREAK AT (1) TO DEACTIVATE CHANNEL "A" TRANSMITTER PERMITS TEST ETC ON UP AND DOWN LINK WITHOUT HITTING SIGNAL ON MAIN CHANNEL

BREAK AT (4) TO DEACTIVATE CHANNEL "A" RECEIVER - THIS PERMITS MONITORING THE "B" CHANNEL ONLY.

BREAK AT (5) AND (3) TO PLACE STATION ON A STANDBY BASIS

EXTRA EQUIPMENT FOR MOBILE RELAY IS SHOWN DOTTED

ANTENNAS ARE NOT SHOWN

APPENDIX "A" - RECEIVER SPURIOUS CALCULATIONS.

MOST OF US ARE FAMILIAR WITH THE IMAGE RESPONSE OF RECEIVERS. BUT THERE ARE ALSO A NUMBER OF OTHER SPURIOUS RESPONSES WHICH EXIST IN ALL RECEIVERS WHICH CAN GIVE US TROUBLE IF A HIGH POWER OR NEARBY TRANSMITTER HAPPENS TO LAND ON ONE OF THEM. THE FOLLOWING ARE THE SPURIOUS RESPONSES WHICH ARE MOST LIKELY TO GIVE TROUBLE IN REPEATER SYSTEMS:

1. FIRST IMAGE - OCCURS AT TWO TIMES THE HIGH I.F. FREQUENCY AWAY FROM THE DESIRED FREQUENCY. AS THE INJECTION VOLTAGE IS NORMALLY APPLIED ON THE LOW SIDE OF THE DESIRED SIGNAL THIS SPURIOUS WILL ALSO APPEAR ON THE LOW SIDE. IF THE INJECTION IS ON THE HIGH SIDE OF THE DESIRED, THE IMAGE WILL BE ALSO.
2. HALF HIGH I.F. - OCCURS AT ONE HALF OF THE HIGH I.F. FREQUENCY AWAY FROM THE DESIRED ON THE SAME SIDE AS THE FIRST IMAGE.
3. SECOND IMAGE - OCCURS AT TWO TIMES THE LOW I.F. FREQUENCY AWAY FROM THE DESIRED FREQUENCY. AS WITH THE FIRST IMAGE IT WILL APPEAR ON EITHER THE HIGH OR LOW SIDE OF THE DESIRED DEPENDING ON WHICH SIDE THE INJECTION VOLTAGE IS ON.
4. HALF LOW I.F. - OCCURS AT ONE HALF THE LOW I.F. FREQUENCY AWAY AWAY FROM THE DESIRED ON THE SAME SIDE AS THE SECOND IMAGE.
5. ALL MULTIPLES OF THE FIRST OSCILLATOR FREQUENCY PLUS OR MINUS THE HIGH I.F. FREQUENCY.

TO ILLUSTRATE THE ABOVE SPURIOUS AND HOW THEY CAN BE COMBATED LET US CONSIDER A HYPOTHETICAL RECEIVER WITH 146.00 MC AS THE DESIRED FREQ. THE HIGH I.F. WILL BE 10 MC AND THE LOW I.F. WILL BE 500 KC. THE FIRST OSCILLATOR WILL BE AT 13.6 MC WITH THE FREQUENCY MULTIPLICATION BEING TEN TIMES TO PRODUCE THE 136.00 MC INJECTION VOLTAGE. THE SECOND XTAL WILL BE AT 9.5 MC. LISTED ARE EACH OF THE SPURIOUS FOR THIS RECEIVER.

1. THE FIRST IMAGE WILL OCCUR AT 126.00 MC. THIS WILL NORMALLY NOT CAUSE ANY TROUBLE UNLESS THE RECEIVER WERE INSTALLED VERY NEAR SOME TYPE OF FAA INSTALLATION USING THIS FREQUENCY.
2. THE HALF HIGH I.F. WILL OCCUR AT 141.00 MC. THIS FREQUENCY WILL ALSO PROBABLY NOT CAUSE ANY TROUBLE IN MOST INSTALLATIONS.
3. THE SECOND IMAGE WILL OCCUR AT 145.00 MC. THE SECOND CRYSTAL COULD BE REPLACED WITH ONE AT 10.5 MC AND THIS WOULD PUT THE SECOND IMAGE AT 147.00 MC. AT ALL COSTS THE REPEATER STATION CHANNEL "B" RECEIVER FREQUENCY SHOULD BE CHOSEN SO THAT THE SECOND IMAGE DOES NOT FALL ON THE CHANNEL "A" TRANSMITTER FREQ.
4. THE HALF LOW I.F. WILL OCCUR AT 145.750 MC. THIS WILL ALSO BE SHIFTED TO THE HIGH SIDE AT 146.250 MC BY SHIFTING THE SECOND CRYSTAL TO 10.5 MC. AS WITH THE SECOND IMAGE THE CHANNEL "A" TRANSMITTER FREQUENCY SHOULD NOT LAND ON THIS FREQUENCY.
5. ONE EXAMPLE OF THE CRYSTAL FREQUENCY MULTIPLES, PLUS OR MINUS THE HIGH I.F., WILL HAVE TO DO. THIS RECEIVER SHOULD NOT BE INSTALLED AT A SITE WITH A BROADCAST FM TRANSMITTER ON 98.8 MC. THE EIGHTH HARMONIC OF THE FIRST CRYSTAL IS 108.8 MC AND THIS MINUS THE 10 MC HIGH I.F. FREQUENCY IS 98.8 MC. THIS TYPE OF SPURIOUS IS NORMALLY QUITE FAR DOWN, AND SHOULD NOT GIVE ANY TROUBLE UNLESS THE RECEIVER IS INSTALLED AT A SITE WITH A VERY HIGH POWERED TRANSMITTER ON ONE OF THE SPURIOUS RESPONSES.

ONE OTHER THING CONCERNING SPURIOUS. TAKE CARE IN PICKING YOUR FREQUENCIES SO THAT HARMONICS OR SUB-HARMONICS OF THE XMTR OUTPUT DO NOT FALL ON THE RECEIVER DESIRED OR RECEIVER SPURIOUS FREQ. FOR EXAMPLE 435 MC WOULD BE A POOR CHOICE FOR A UHF CONTROL FREQUENCY AS THE TRIPLER WOULD FALL ON THE 145 MC 2ND IMAGE OF THE ABOVE RECEIVER. HOWEVER, IF YOU HAD THIS TROUBLE IT COULD BE CURED BY SHIFTING THE SECOND XTAL TO 10.5 MC AND THUS MOVING THE SECOND IMAGE TO 147 MC.

XXXXXXXXXXXXXXXXXXXXXXXXX
X X
X NATIONAL WIDE-BAND FM X
X CALLING AND WORKING X
X FREQUENCIES X
X 52.525 MC 146.94 MC X
X X
XXXXXXXXXXXXXXXXXXXXXXXXX

- THE -
- F. M. -
- N E W S -

VOL. III NR. I
MAY/JUNE 1964

XXXXXXXXXXXXXXXXXXXXXXX
X X
X -- THE BOX SCORE -- X
X NUMBER OF STATES ON X
X 52.525 MC 146.94 MC X
X 33 27 X
X X
XXXXXXXXXXXXXXXXXXXXXXX

THIS ISSUE OF THE "NEWS" IS ACTUALLY THE 1964 EDITION OF THE YEARLY "F.M. NETS". TO SOME SUBSCRIBERS THIS WILL BE THEIR FIRST ISSUE OF EITHER THE "NEWS" OR THE "NETS". TO ALL OF THEM IT IS THE FIRST ISSUE OF THE "NEWS" SINCE AUGUST 1963 (VOL II NR IV). HERE IS THE STORY:

OUR PURPOSE IN PUBLISHING THE "F.M. NEWS" WAS TO STRENGTHEN THE FM MOVEMENT DURING ITS EARLY GROWTH BY HELPING TO COORDINATE AND INFORM ENTHUSIASTS. WE STATED IN ALMOST EVERY ISSUE THAT THE "NEWS" WOULD HAVE TO BE SUPPORTED BY OUTSIDE CONTRIBUTIONS OF ARTICLES. IN THE BEGINNING SOME WERE RECEIVED, USED AND CERTAINLY APPRECIATED. BUT AFTER A WHILE THEY STOPPED AND SO THEN DID THE "NEWS". OUTSIDE OBLIGATIONS OF THE EDITORS BECAME MORE PRESSING AT THE SAME TIME WHICH ALSO AFFECTED THE PUBLICATION.

WE HAVE DECIDED TO MAKE THIS THE LAST OFFICIAL (PAID) ISSUE. THE "NEWS" HAS INCLUDED ALL SUBJECTS PLANNED INITIALLY BY THE EDITORS, EXCEPT ONE. THIS WAS "TONE OPERATION" AND WE HOPE IN THE FUTURE TO DO THIS. WE WILL KEEP OUR MAILING LIST IN ORDER TO DISTRIBUTE ANY FUTURE EDITIONS.

IN ORDER TO FULFILL OUR OBLIGATION TO SUBSCRIBERS WE ARE RETURNING SUBSCIPTION MONEY TO OUR RECENT SUBSCRIBERS WHO HAVE HAD NO BENIFIT FROM IT. THOSE RECEIVING A REFUND WILL SEE A RED CHECK BESIDE THIIR NAME ON THE BACK WHERE YOUR ADDRESS IS. THIS IS BEING MAILED UNDER SEPARATE ENVELOPE. ANYONE WE HAVE OVERLOOKED OR WHO DOES NOT RECEIVE THIS ENVELOPE WITHIN A WEEK PLEASE DROP US A POST CARD. MONEY RECEIVED SPECIFICALLY AS A DONATION WAS USED AS SUCH. YOU WILL FIND A FINANCIAL STATEMENT AT THE BOTTOM OF PAGE TWO WHICH WILL CLARIFY OUR POSITION AND PERHAPS GUIDE OTHERS WHO MAY BE CONSIDERING THIS TYPE OF VENTURE.

REMOTE CONTROL - THERE IS PRESENTLY LICENSED A REMOTELY CONTROLLED HAM-FM SYSTEM (IN THE EAST) WHICH IS LEGALLY CONTROLLED BY THREE DIFFERENT AMATEURS. WHEN APPLYING FOR THIS TYPE OF LICENSE, ALL LICENSEES SHOULD APPLY AT THE SAME TIME ALONG WITH A COVERING LETTER. THE FOLLOWRAING PHILOSOPHY SHOULD BE USED: 1) WHY HAVE (3) SEPARATE STATIONS AT ONE LOCATION WHEN ONE WILL DO THE JOB? 2) EACH LICENSEE WILL HAVE A SEPARATE AND DISTINCT CONTROL ACCESS. 3) EACH LICENSEE WILL BE IN CONTROL OF THE REMOTE TRANSMITTER(S) AT A SEPARATE AND DISTINCT TIME FROM THE OTHERS, TURNING IT ON-LOGGING-IDENTIFYING-MONITORING-ETC-TURNING IT OFF. IN OTHER WORDS ONLY ONE LICENSEE CAN BE IN CONTROL AT ANY ONE TIME.

NATIONAL FREQUENCIES - WE HAVE SEEN A LARGE INCREASE OF THE NUMBER OF STATIONS ON "525" AND "94" RECENTLY. THIS HAS BEEN ESPECIALLY NOTED BY PEOPLE WHO TRAVEL A LOT IN THEIR MOBILES. THEY ARE VERY HAPPY TO BE ABLE TO CONTACT PEOPLE IN THE MAJORITY OF AREAS OF TRAVEL. MORE AND MORE LOCALITIES ARE SWITCHING FREQUENCY. THIS HAS PICKED UP CONSIDERABLY SINCE THE PUBLICATION OF THE FREQUENCIES IN "QST". JUST FOR INTEREST, THE FIRST "FM NEWS" IN SEPTEMBER 1962 CARRIED THE BOX SCORE OF 23 AND 15.

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X X
X ALL CORRESPONDENCE CONCERNING THE FM NEWS SHOULD BE ADDRESSED TO: X
X SEYMOUR PAUL, K4FSU, RT. 2, WATERLICK RD., LYNCHBURG, VA. 24501. X
X X
YXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXX

ANGOLA PICNIC - THE 5TH ANNUAL WIDE-BAND F.M. PICNIC WILL BE HELD AT THE STEUBEN COUNTY 4-H PARK JUST NORTH OF ANGOLA, INDIANA ON AUGUST 2, 1964. THIS EVENT IS ALWAYS LOOKED FORWARD TO BY ALL THE FELLOWS WITHIN DRIVING RANGE. NICE PRIZES ARE AWARDED AND YOU DON'T HAVE TO BE PRESENT TO WIN. A FREE BEACH IS NEARBY AND THE XYL AND KIDS ARE ADMITTED FREE. THE COST IS $1.00 IN ADVANCE, $1.50 AT THE DOOR. DINNER IS AVAILABLE IF YOU WRITE AHEAD AND PAY BY JULY 25. SPONSORED BY: THE TRI-STATE COLLEGE AMATEUR RADIO CLUB, ANGOLA, INDIANA 46703. PINIC HELD RAIN OR SHINE.

WE HAVE HEARD THE FELLOWS AT TRI-STATE MAY PUBLISH THE 52.525 MC DIRECTORY AGAIN. WE HOPE THAT THEY WILL AND IT IS WELL WORTH OBTAINING. IF IT DOES BECOME AVAILABLE YOU WILL PROBABLY SEE IT ANNOUNCED IN "QST".

LATE FLASH - SKIP OPENINGS HAVE CHANGED THE 52.525 BOX SCORE TO 35.

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"F.M. NEWS" FINANCIAL REPORT

EXPENSES:	AUG 62	2000 SHEETS PAPER	$ 7.50
	SEPT 62	PRINTING HEAD (1000 SHEETS)	4.00
	DEC 62	125 (3 CENT) STAMPS	3.75
	JAN 63	1000 SHEETS PAPER	3.75
	JAN 63	40 (3 CENT) STAMPS	1.20
	FEB 63	1000 SHEETS PAPER	3.75
	FEB 63	250 (4 CENT) STAMPS	10.00
	APR 63	10,000 SHEETS PAPER	31.10
	APR 63	100 STENCIL MASTERS	7.35
	JULY 63	250 (4 CENT) STAMPS	10.00
	JUNE 64	3000 SHEETS PAPER	10.50
	JUNE 64	350 (4 CENT) STAMPS	14.00
		TOTAL	$106.90

(FOR 7 ISSUES THIS CAME TO $15.27 PER ISSUE)

INCOME -$163.70
(FOR 350 SUBSCRIPTIONS)

RETURNED -$ 78.50

NET LOSS -$ 21.70

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6-18-64

WHY A NATIONAL WIDE-BAND FM CALLING & WORKING FREQ. ?

1. The presently designated National Calling & Working Freq. are no good for FM. On 6 meters wide band FM is not permitted below 52.5 Mc. On 2 meters the majority of activity is centered near 147 Mc. rather than near the 145.35 Mc calling freq.

2. FM operation should be encouraged as we are populating the "unused" upper portion of each band.

3. Ham FM operation cannot help but grow. Large amounts of commercial FM gear will be obsolete for commercial use by 1963 due to the new FCC commercial regulations. In most cases this gear will be available to hams at little or no cost. A national channel for each band will help to assure that this growth is orderly.

4. Because crystal controlled receivers are used a national frequency is required for a mobile rig to be usable in other than its home area. No national freq. means very few contacts away from home.

5. A set of crystals for an FM rig will cost in the $6 to $10 range. John Q. Ham can be saved this amount (spent for a second set of Xtals) only if he knows which freq. to buy these Xtals for in order to get maximum use out of his gear.

6. The listing of NATIONAL WIDE-BAND FM CALLING & WORKING FREQ. will be much more successful than have been the AM National Calling and Working Freq. This is because of the Xtal controlled receivers and the universal use of squelch circuits in those receivers. Hams using FM monitor their freq. very religiously because the squelch makes monitoring painless. With the Xtal controlled receiver you always know that if the other fellow is listening he has to be listening to the right freq. A national channel will make this "right" frequency the same throughout the nation.

WHY 52.525 Mc.?

52.525 Mc. was selected as the National Wide-Band FM Calling & Working Freq. for 6 meters for several reasons. This freq. has the majority of 6 meter FM operation. It enjoys the greatest freedom from Ch. 2 TVI problems as it is as far removed from Ch. 2 as is possible consistent with staying above the 52.5 Mc. FCC limit for wide band FM. The stations on this freq. desire that it be a nationally used freq. This is in contrast to some stations on other freq. who fear national usage because of skip interference problems.

WHY 146.94 Mc.?

146.94 Mc. was selected as the National Wide-Band FM Calling & Working Freq. for 2 meters for several reasons. It is near the original design freq. of the equipment. That is, it is in the upper portion of the band. It is RACES. It is in the Technician band. It is on a CD recommended 60 Kc. channel. It can be switched to from both 146.76 and 147.30 Mc. (The leading channels in usage). Many of the new nets which have started within the last 2 years have picked freq. in the 146.90 to 146.98 Mc. range. This shows the strong trend to locate in this portion of the band. If future new nets locate on 146.94 and if existing nets use it as a second channel it should be only a matter of a year or so before this channel has nationwide usage as 52.525 Mc. has now.

K4ZAD 7/22/61

NATIONAL WIDE-BAND FM
CALLING AND WORKING
FREQUENCIES

52.525 Mc 146.94 Mc

WHAT YOU CAN DO TO HELP OBTAIN A NATIONAL WIDE-BAND FM FREQ.

Many of us have, from time to time, dreamed of driving anywhere in the U.S. and being able to use our FM gear. Although this may sound like a dream it is really something which is within our reach if only we will put a little work into obtaining it.

The big problem in obtaining nationwide usage of a particular FM frequency is that of making the desired frequency known to those just getting interested in FM. The problem then becomes one of publicity. We can all help in a publicity effort aimed at obtaining nationwide usage of the frequencies proposed at the top of the page. The following methods may be employed to further this publicity effort:

1. Spread the information on these freq. by word-of-mouth when on other bands or when traveling etc.
2. Do everything possible to encourage FM activity in areas somewhat removed (50 to 125 miles) from your own area.
   a. Set up a schedule with a friend in a non FM activity area. Use FM on both ends of the circuit. This will probably require the use of beams, and may require the use of high power. However, you will get the freq. established in a new area.
   b. Travel in groups of 2 or 3 cars to hamfests in adjacent areas. Nothing sells FM like a first hand demonstration.
3. Whenever writing anything in the report line (to SCM's, SEC's, VHF Editors, Etc.) be sure to mention the freq. and the mode of operation (FM, of course).
4. Last, but most important. We need the box at the top of the page reprinted in the national magazines each month much as the RTTY frequencies are now printed in the Operating News Section of QST. Write your ARRL Director, ARRL Hq., Editor CQ, Editor 73 expressing your support for the monthly reprinting of the above box in their magazine.

It will take you about 20 min. and cost you 12¢ to accomplish number 4 above. Cards from each of us using FM are needed in order to get the magazines to list the above info. They will never list it unless <u>you</u> ask for it. Don't put it off, as the requested listing is the only way we have of reaching the new FM'er before he buys his crystals.

The magazines have already been informed of the frequencies, the reasons for the selection of these particular frequencies, and the reasons why National Wide-Band FM Calling & Working Frequencies are necessary. It only remains for you to back up this info. with your supporting postcards.

K4ZAD 7/22/61